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THE

JOURNAL OF SCIENCE.

MAY, 1884.

I. STELLAR PHOTOGRAPHY.

By T. E. Espin, B.A., F.R.A.S., Special Observer to the Liverpool Astronomical Society.

THE great and rapid improvement in the sensitiveness of dry plates for photography has at length allowed of successful photographs being taken of some celestial objects. At the Oxford Observatory for some time the moon was photographed with a 13-inch reflector on every available night, and the photographs have been so perfectly taken that they allow of measurement under high microscopical power. The possibility of photographing the moon has, however, long been known. But with the other heavenly bodies the matter is a somewhat difficult one. The image formed at the focus of the telescope is so extremely small, and the difficulty of following the celestial object—whatever it may be—so great, that the results hitherto obtained are not more curious than of scientific value. M. Common, with a reflector of 37 inches aperture, has however succeeded in photographing the planets Saturn and Jupiter. With a powerful magnifying-glass it is possible to see the ring of the former, and the photographs that have been obtained of the latter show some detail on enlargement. The red spot which has been the chief object of interest so long was visible on one photograph. The difficulty of photographing any detail on this planet will be the possibility of extremely short exposure; for the rapid rotation of the planet on its axis, *viz.*,

about ten hours, quickly causes a displacement of the details visible at the time of observation.

With Saturn the image is so small that we cannot hope at present for much information from the photographs obtained of them.

The curious objects scattered up and down the heavens, and called nebulæ, form a much more likely class. The difficulty of drawing these objects is very great. Different observers are struck with different detail, and the keener-sighted observer will give an entirely different form to some wisp or patch which is figured by both. Hence the various drawings of the great nebula in Orion seem to show the light grasping powers of the instruments used, and the keenness of the observer, rather than an actual change in the nebula itself. If, then, the nebula could be photographed from time to time, there would be a means at once of determining whether any change had taken place. This has actually been done by Dr. Draper in America, and by M. Common in England, both using large reflectors. M. Common's photograph, being taken with the largest aperture, shows of course the greatest amount of detail, but the glare from the brighter stars destroys the photograph of the parts of the nebula near them.

But besides this field there is yet another where valuable work may be done. The photographic plate is most sensitive in the violet part of the spectrum, and least sensitive in the red. Hence the image impressed upon the plate will be the result of the violet light emitted or reflected from that object. Supposing two flames, one of red and the other of violet colour, were photographed on the same plate with the same exposure, although in intensity to the eye the red might be far the brightest, yet, since the plate is most sensitive to the violet, the brightness of the images on the plate would be reversed, the violet one coming out many times brighter than the red one. Now the stars are of various colours, some white, others blue, some red. If, then, the stars were photographed, the intensity of the image on the plate—just as in the case of the two flames—would be greatest for those stars which emitted most violet light. In this way it would be possible to obtain an accurate record of the violet light in the stars.

Again, the violet light is chemical light. All life, animal and vegetable, depends upon this chemical light. If less than a certain amount, all life would cease in all probability; while, on the other hand, if greater, its very intensity would kill plants and animals, or else produce a very exaggerated

state of life. The late Sir W. Siemens made some experiments on the action of the electric light, which contains a very large percentage of chemical light. He found that when plants were exposed to its light they grew at a great rate. Fruits could thus be forced at any season of the year. But he also found that if the light was left bare it quickly, by its chemical intensity, killed the plants. To prevent this the light was placed in a glass globe, glass being a great absorbing medium of the chemical rays of light.

Various attempts have been made to photograph the stars. Prof. Pickering, in America, has photographed the Northern Heavens, to make a map and determine the magnitudes. The writer of the present paper has endeavoured to go a step further, and tried to determine relatively the chemical light in the stars by means of photography. Using a lens over 2 inches in aperture, various plates were taken of the most prominent stars with very interesting results. Alpha Lyræ, which is a very white star, left an impression on the plate with only five minutes' exposure. Alpha Cygni, a star of the same colour, impressed itself with equal rapidity. With long exposures, of one hour and a half, as many as 120 stars were photographed on a plate of greater size. On one plate over forty stars were photographed in the Pleiades, a cluster the stars of which seem to possess a large amount of chemical light. The red or orange stars, as was to be expected, came out comparatively faint on the plate. In the case of *α* Cete, a star consisting of a second magnitude orange star and a $6\frac{1}{2}$ mag. blue, a result was found confirming Prof. Pickering, *viz.*, that the blue star came out the brighter of the two. In some cases, however, where there is little or no difference in colour to the eye, the impression on the plate in no way corresponds to the star's magnitude. Hence a new line of research is opened up—a research into the actinic light of the stars. Using the ordinary magnitude scale as the basis, it is possible to deduce magnitudes from the photographic plate and compare them with the eye magnitude. Obviously all the stars photographed will fall into one of three classes; they will be equal in magnitude to the star's magnitude as determined by the eye, or they will be above it, or else below it. Hence we have a new method of determining accurately the star magnitudes, on the one hand, and on the other of cataloguing stars whose chemical light is either greater or less than the light that affects the eye. The star magnitudes can be determined from the photographic plate with the greatest accuracy, and with one great advantage—that the photograph can be taken

and the plate developed and put away, and be available at any time for the determination of the star magnitudes. Besides this it is a valuable thing to have a record which is practically free from errors of the stars visible at a given time in a given part of the heavens.

The Liverpool Astronomical Society has lately, through the munificence of Mr. Howard Crabb, been able to set up apparatus for carrying on the work of Stellar Photography. This is an Equatorial Stellar Camera, driven by clock-motion, and fitted with a compound lens $4\frac{1}{2}$ inches in aperture. Already some fifteen hundred or more stars have been photographed. The number of stars on any one plate depends on two conditions—the sensitiveness of the plate and the length of exposure. The great clusters in Gemini and Cancer, and the spiral nebula in Canes Venatici, have already been photographed, as well as several double and variable stars. Doubtless as the work progresses many interesting results will be obtained in so new a line of research.

II. INCIDENTS OF THE EARLY LIFE OF FRIEDRICH WÖHLER.

(Born July 31st, 1800; Died September 23rd, 1882.)

By Miss Katherine Windscheid.

FRIEDRICH WÖHLER was the descendant of a family in comfortable circumstances, living in Central Germany. His grandfather was Master of the Horse to the Landgrave William IX. of Hessia; his son, August Anton, Wöhler's father (born January 28th, 1771), studied the veterinary art and rural economy, according to the wishes of his family, though without any special inclination. Far, however, from preparing himself exclusively for this vocation, he had profited so well by a sojourn of several years at the University of Marburg, studying the different branches of philosophical and philological science, that on

leaving the university he not only possessed vast learning, but the compass of his understanding went far beyond his professional sphere. Almost immediately after the conclusion of his academical studies the young man was named, by the Landgrave of Hessia, Master of the Horse to his son and heir, who resided at Hanau. Their relations, however, were destined to end in a peculiar manner, as will be told further on. Anton Wöhler now entered, in the same capacity, the service of the Duke of Meiningen, at whose Court he soon gained an influential position by the numerous reforms which he introduced in rural economy.

Court life, however, seems not to have agreed with his love for independence. In the year 1806 we find him the happy possessor of an estate in the neighbourhood of Frankfort-on-the-Main. But a few years later the brilliant results of his farming method had attracted the attention of wider circles, and Wöhler was induced by the "Fürst Primas Dalberg" to settle down as Master of the Horse at the Grand-Ducal Court. Here this excellent man entered upon the right field of action, and henceforth devoted himself with extreme success to the furtherance of what was good and beautiful. There existed no society, working either for the intellectual or the moral welfare of the citizens, in which he did not eagerly participate. The Wöhler School, founded twenty years after his death, and greatly prospering at the present moment, is the best proof that his work is held in grateful remembrance by a later generation.

An interest similar to that evoked by the contemplation of this rich life is due to his wife, though as regards her we do not possess such extensive information. She was the daughter of the Head-master of the College at Hanau,—a tall, stately lady, who enjoyed up to her latest days the most perfect health. Those who knew her describe her as a clever woman, endowed with inexhaustible good humour, and with a gift of looking at life in a gay and highly original manner,—a woman who was never at a loss for a proper word at the right moment.

This short glimpse of the home of Wöhler's parents is all the more certain to excite our sympathy as it shows us the favourable circumstances which attended his development.

Friedrich Wöhler was born on the 31st of July, at Eschersheim, in the house of his mother's brother-in-law, who was then the clergyman of the village. The reason why his mother was not at home on the eve of so momentous an event deserves to be recorded, as it characterises the state of affairs in Germany at that period. Her husband was

then, as has been said, Master of the Horse to the "Kurprinz" of Hessia, a potentate not represented by history in a flattering light. His impetuous and violently passionate temper knew no bounds. As he visited his stables one day in the company of his Master of the Horse, some trifling circumstance excited his anger to such a degree that he insulted him in the most unbearable manner, and finally proceeded to acts of violence. This was too much even for our good Wöhler; he seized a riding-whip, and gave his Highness such a correction as probably he had often deserved, yet never received. A good horse soon removed the avenger out of the immediate jurisdiction of the chastised potentate, and the Prince, justly fearing to appear ridiculous, had sense enough not to prosecute the fugitive. Wöhler's family, however, was obliged to leave the town in a hurry, and his wife was most happy to find refuge in the house of her brother-in-law.

When the boy had attained his seventh year, his father himself taught him the rudiments of reading, writing, and drawing. He then was sent to a public school, and afterwards took private lessons in Latin, French, and music.

In the year 1814 Wöhler entered the Gymnasium at Frankfort, where he pursued his studies up to the time he left for the University. He regularly went to school, and was promoted to the higher classes after the usual time, yet did not distinguish himself, as he afterwards candidly acknowledged, either by zeal or by learning; the reason being that he was constantly engaged in chemical experiments, as well as in the gathering of minerals, and thus his tasks were often neglected. To this early awakened passion he was indebted for the honour of being presented to Goethe, whom he met in the shop of a dealer in minerals.

Dr. Buch, a man of high culture, a physician by profession, had great influence on Wöhler's scientific career. It was from him that he received the first impulse for serious physical studies. He published in 1821 a little essay, at the head of which Wöhler's name appears for the first time in literature. The use of Dr. Buch's well-assorted library better enabled him to fathom the secrets of chemical processes, and soon experimental research became with him an all-absorbing passion. There were other things besides that interested the boy. He had regular lessons in drawing, made sketches from Nature, and even tried his hand at oil-painting. Under the direction of a young painter, with whom he took lessons, he began to study more closely the poetical literature of his country, which then had already obtained a high degree of perfection.

When Wöhler was a boy Germany languished under the unbearable yoke of the French invaders. He was too young fully to feel the heaviness of the oppression, too young to share the glorious impulse which aided in liberating Europe from the hated tyrant, yet he preserved in later years a vivid recollection of the great events of that time.

Meanwhile our young friend had, from a feeble and even sickly boy, grown to be a strong bright youth. He himself attributes this happy transformation to the extreme care which his parents took of his physical development, and to their sensible way of strengthening his constitution.

In the spring of 1820, when nearly twenty years old, Wöhler went to the University. A family council had determined that he should study medicine, partly because favourable circumstances seemed to assure him a prosperous future in this line, partly because his own inclination pointed in that way. The first year he spent at Marburg, where his father had studied before him, and where several old friends of his family still lived, who had been requested to guide the inexperienced youth. He attended lectures on Botany, on Physics and Mathematics, as well as on Anatomy, and at the expiration of the year exchanged Marburg for Heidelberg. His mind was filled beforehand with enthusiasm for Prof. Gmelin, who then lectured on Chemistry at that town, and who throughout his College life remained his true friend and benevolent adviser. He ardently wished to attend his readings: Gmelin, however (in Wöhler's case), considered it a waste of time, and thus it came to pass that he, of all men, never heard lectures on Chemistry. He greatly profited, however, by the opportunity of working in his laboratory. Nearly all the time he could spare from his medical studies he devoted to Chemistry. He began the experiments on cyanogen, the results of which he deposited in two essays, published in 1821 and 1822. In their author we already recognise the accomplished man of Science.

Wöhler still intended to become a practising physician, his inclination for this vocation strengthening as he gained more precise knowledge of the practical side of medical science. In September, 1823, Wöhler and a friend of his took their degree as M.D. It had been decided that Wöhler should now go abroad, in order to visit larger hospitals. Another direction, however, was given to his life by Prof. Gmelin, who advised him to abandon the medical science, and to devote himself wholly to Chemistry, a proposal to which Wöhler immediately consented. Stimulated by Gmelin, and encouraged by the friendly manner in which his

first essays had been criticised by Berzelius, he applied to the latter for permission to work in his laboratory. Berzelius replied in the most benevolent terms, and this first letter opens the long and most interesting correspondence which united Wöhler and Berzelius up to the time of the death of the latter.

III. THE GHOST OF THE SEASON.

By "ARGUS."

RE-APPEARANCES and even re-incarnations of the dead, I am told, have undergone a marked revival. They are no longer laughed at as dreams or impostures of by-gone days, but meet with respectful attention from men of learning and repute. This change in public temper may, perhaps, help to account for a fact lately witnessed, above all places, in the rooms of the Society of Arts. There and then was manifested the ghost, not of defunct man or woman, but of a three-headed being which during its lifetime had "neither a soul to be lost nor hinder-quarters to be kicked," and which is generally thought to have made ample use of this privilege. In other words, the shade or "shell" of the late Royal Rivers' Pollution Commission has possessed or "obsessed" a living man, and compelled him to reproduce once more its notions and its recommendations.

Of this Commission I have no wish to speak harshly or imputatively. It possessed ample scientific attainments, but was not burdened with practical common sense. It had, from the very outset, strong prepossessions, and it appears mainly to have sought evidence for their confirmation. It told us little that was new, and suggested, perhaps, still less that was feasible. But had it not been for this ill-timed and injudicious re-appearance the world would have been quite willing to forget its shortcomings, and not to inquire too closely as to the benefit derived by the nation in return for a heavy outlay of public money.

Yet, like many other and doubtless abler men, I feel bound to re-examine the views which were once more thrust upon us on March 13th.

I will first take in hand one of the fundamental dogmas of the Commission. This may be fairly embodied in the following words:—"If a river be once polluted by sewage matter, the water of that river was for ever unfit for dietetic purposes, and no practical distance of flow would render such a river safe." This dogma is professedly based upon the experiments of Prof. Frankland. He has made analyses of water taken from different portions of a polluted river, and has told us that as it flows its proportion of pollution—*i.e.*, of organic impurities—remains substantially the same. He has also, after determining the impurities in a sample of sewage, mixed similar sewage with water and shaken it up with air in a bottle, in order to ascertain if the impurities were to any extent destroyed by oxidation! It is difficult to imagine how any man accustomed to scientific research, and acting in good faith, could persuade himself or try to persuade others that this experiment in the least degree reproduced the conditions found in a river. In a river there is doubtless, as in the bottle, contact with air and exposure to light: but in the river there are agencies which were absent in the bottle. There are animals of low grade which devour the filth; there are vegetables—all water-plants—which, whenever the sun shines, and even under the influence of diffused daylight, give off oxygen, and oxidise, or in common language burn up, the impurities. Both these agencies, I repeat, were wanting in Prof. Frankland's bottle, whilst they are present more or less in every river. In the Thames above London they are certainly not wanting.

But leaving this bottle experiment, as a something childishly inadequate, let us look to observations made on the large scale. It is well known that the River Oder, the main water-course of Prussian Silesia, passes through the city of Breslau, and receives all the household sewage and industrial waste waters of that large city. Dr. F. Hulwa has recently made a very careful examination of the water of the river. He finds naturally a progressive deterioration as it flows through the city, reaching its maximum at a point where the sewers discharge themselves. But on following the stream lower down there was a progressive improvement, the water being purified by the oxygen of the atmosphere and the action of vegetation. At the distance of 14 kilometres below Breslau, or in English measurement a little more than 9 miles, Dr. Hulwa found that the sewage

matters could neither be detected chemically nor microscopically, and that the water was of the same quality as above the city. The report in full may be found in the "Gesundheits-Ingenieur," a well-known German journal of sanitary science.

These investigations, I presume, had not come to the knowledge of the defunct Commission in its land of shadows.

From Silesia we turn to the State of Delaware. Professor A. R. Leeds, a chemist of well-known standing, has conducted very careful and prolonged experiments on the pollutions of the Passaic and the Brandywine Rivers. He concludes that "there is no foundation in fact for the oft-repeated statement that water once polluted by sewage can never again become safe for drinking purposes." In addition to the action of the atmosphere and of water-plants, he points out that the finely-divided earth washed into the river by rains occludes and precipitates the impurities. The Passaic river, it appears, is pure down to the town of Paterson, where it is polluted by the sewage and manufacturing refuse. Yet 16 miles lower down it returns to a condition of purity little inferior to what it exhibits above Paterson, and serves as a water-supply for the 300,000 inhabitants of Jersey City and Newark. Dr. Leeds writes:—"The river immediately below the town is black with dye-wares; the fish carried over the Falls are immediately poisoned, and I have often seen the foul-smelling and disgusting water covered with their floating carcases." Yet samples taken at intervals of a mile apart down the river show a regular diminution in the organic nitrogen, and a disappearance of the nitrites. To give the actual figures, just above Paterson the albumenoid ammonia was found to be 0·016 grain per gallon; below Paterson it had risen to 0·068 grain; whilst at Broadway Bridge it had sunk to 0·024, and at Dundee Dam to 0·018 grain per gallon. Thus the gradual oxidation and disappearance of the organic matter is distinctly shown. A full account of the observations and experiments of Prof. Leeds may be seen in the "Annual Report of the Chief Engineer for the Water Department to the City of Wilmington, Delaware, for the Year 1882" (Wilmington: James and Webb), and "Pollution of the Passaic River" (Newark: Inglis and Co.); or see "Chemical News," March 30th and June 22nd, 1883 (pp. 153 and 292).

A third case may also be noticed. The River Vesle, above the town of Rheims, is fairly pure. It is severely polluted on its passage through Rheims, which has been called the

French Leeds, but further down it gradually returns to the same condition which it had above the town. These successive changes, first for the worse and then for the better, were shown by the volume of free oxygen held in solution in the water, as determined by De Lalande's process. As the impurities increased this free oxygen very naturally diminished, thus proving, by the way, that such free oxygen does actually serve for consuming organic impurities, and that if these exceed a certain quantity it is all used up faster than it can be absorbed from the atmosphere. But as the stream flowed on the absorption of oxygen continued, and it gradually gained ground and was able to destroy the impurities. By degrees, too, water-plants and animals of higher grades, which were unable to exist immediately below the town, now appeared and completed the work of purification.

I admit, of course, that if the quantity of pollution is too great in comparison to the volume of the river,—if water-plants and animals are poisoned by manufacturing refuse, and if the supply of filth is continuous all along the course of the river,—its waters will fail to be purified by the natural agents above mentioned. But this is a very different proposition from the sweeping conclusion of the Commission. Whether living organisms, present as an impurity in water, are capable of being oxidised and destroyed by aëration, by the action of aquatic vegetation, or whether they are capable of being removed in any other manner, is a distinct question, to which I shall revert below.

The dogma of the Commission is to some extent based upon the analytical method used by them, or, more strictly speaking, by Professor Frankland. I am not about to enter upon a discussion of this method, or to undervalue it in comparison with any other method. But as Dr. Percy Frankland asked his audience to condemn the A B C process for the purification of sewage, upon the strength of an analysis made by that method, I am compelled to bring forward a certain historical fact.

In the beginning of the year 1872 the Native Guano Company, proprietors of the A B C process, were beginning to treat the sewage of Leeds. A formal trial of forty-eight hours was made under the superintendence of the Sewage Committee of the Leeds Town Council. Every hour a bottle of the effluent water was taken and sealed by officials of the Council, and at the end of the forty-eight hours the contents of these bottles were poured into a large vessel, and thoroughly stirred up together. It is therefore evident that any two samples of water taken out of this vessel

[*Copy.*]

RESULTS OF ANALYSIS EXPRESSED

Number of Sample.	Description.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.
A.	... ...	107·7	2·179	0·566
—	Bedford Water	108·4	2·042	1·017

	Hardness.		
	Temporary.	Permanent.	Total.
A.	7·9	40·7	48·6
Bedford Water	2·2	32·8	35·0

must have been identical. Two Winchester quarts were filled with this water by the officials of the Town Council, sealed, and despatched to Prof. Frankland for analysis. The one was forwarded direct to London, whilst the other was sent to a gentleman in Bedford, who at once sent it on to Prof. Frankland. Neither of these bottles was ever in the custody of any person connected with the Native Guano Company. The results of the analysis of the two samples were in course of time received by the Leeds officials, the one directly and the other *viâ* Bedford, and are indeed instructive. They are here subjoined. The originals, duly signed, are in existence, and can, I am told, be produced if needful.

Thus it will be seen, if we turn to the most important points, that of these two identical samples the one which had come direct from Leeds is represented as containing nearly double the amount of "previous sewage contamination" which was present in the other! Again, whilst the difference between the two samples in "total solid impurities" and in chlorine is trifling, the difference in "organic nitrogen" is nearly 50 per cent, that in "ammonia" nearly 30 per cent, and that in "nitrogen as nitrates and nitrites" above 80 per cent. What can we think of analytical methods by which such results are reached? Yet it was on the faith of such methods of analysis that the A B C process for the purification of sewage was condemned by the Rivers' Pollution Commission. It is on the faith of one of these analyses, exhumed, so to speak, for the

IN PARTS PER 100,000.

Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Previous Sewage Contamination.	Chlorine.
1·550	0·372	2·214	1·6180	14·6
1·020	0·062	1·919	0·8700	14·0

Suspended Matter.

Mineral.	Organic.	Total.
0·68	0·54	1·22
1·82	0·06	1·88

occasion, that the old condemnation was repeated on March 13th.

I have here to complain of something very like intentional unfairness on the part of Dr. Percy Frankland as regards his attack upon the A B C process. The man who, professing to have given any serious attention to the sewage question, can yet endorse the statement of the defunct Commission, that "after treatment by this process the effluent sewage is very little better than that which is obtained by allowing raw sewage to settle in subsidence-tanks," is, to say the least, guilty of most culpable rashness. Any person who heard Dr. Frankland read his paper would be apt to think that the analysis which he quoted had been made recently, instead of fourteen years ago, and that the sample operated upon had been taken at some place where the A B C process was in actual operation in London. But if we turn to the Report of the "Commissioners" we find the whole history of this analysis. Some London sewage was obtained by the Commissioners, and treated by them by the A B C process, and was then analysed. Who guarantees the correct execution of the process, or, after the figures I have above quoted, the accuracy of the analysis? No check sample could be taken to be submitted to any other chemist. Nay, the Report itself contains an admission that the treatment of the water was not fairly, or at least judiciously, performed. The sewage, we are told, after the A B C mixture had been added to it, was well shaken for five minutes. This alone was enough to prevent the precipitation from

being properly effected. It is surely singular and significant that Dr. Percy Frankland should have contented himself with this old analysis, and never taken the trouble even to inquire whether it and the conclusions based upon it were still applicable at the present day. Surely a wish to deal out even-handed justice would have dictated a different course. I learn that he has since applied for, and I believe received permission, to take samples of the sewage and effluent at Aylesbury. Would not this step have come with a better grace before his paper had been read?

There is another point which here deserves notice. In the Commissioners' analysis quoted by Dr. Percy Frankland the ammonia in the effluent is found to be greather than that in the raw sewage. This is true, but wherefore? In those days of "ancient history," as Mr. Norman Bazalgette not unhappily calls them, ammonia-alum was used in the A B C process, and a certain quantity of ammonia was thus introduced. But for twelve years this ammonia-alum has been abandoned in favour of so-called cake-alum, aluminium sulphate, which contains no ammonia. Now Dr. Percy Frankland either knew of this important alteration or not. If not, his acquaintance with the A B C process and its working is indeed archaic. If he knew of it and kept silence, what shall we say of his candour?

In the analysis of the two identical samples of Leeds sewage quoted above there is an item "total solid impurity." It was the custom of the Commissioners to class everything found in water beyond the oxide of hydrogen as "impurity." So it certainly is from an abstract chemical point of view. But from a sanitary point of view it is no such thing. All ordinary waters contain carbonates and sulphates of lime and magnesia, sometimes also traces of iron and silica. But it is far from being demonstrated that these impurities are detrimental to health. In fact the balance of medical opinion seems to incline to the conviction that soft waters—*i.e.*, those free from such "impurities"—are dietetically inferior to moderately hard waters. Surely, then, to speak of such matters as "impurities" in documents drawn up in the interests of public health, savours strongly of sensationalism. It was a great misfortune that the Commission did not include at least one physician.

I come now to the consideration of the living organisms —bacteria, or other microbia—which are now commonly supposed to be the agents of infection. The question has been raised whether these "germs," if present in sewage, can by any treatment, chemical or mechanical, be either

kept back from entering the streams along with the effluent, or, if not kept back, can they be destroyed by oxidation or by any other process? Professor Frankland seems to have attended and testified that these "germs"—like nuisances generally—are very tenacious of life. He told his hearers that they might be boiled for three or four hours without being destroyed, and that they were little affected by cyanogen and sulphurous acid. Dr. Jabez Hogg, the eminent microscopist, also declared that oxidation in the flow of a river could have little effect upon living organisms, however efficient it might be in the removal of dead organic matter. All this may, for argument's sake, be very well admitted, though it is important to note—as Sir Robert Rawlinson pointed out—that cholera can at all events originate on a very large scale independently of germ-polluted waters, whilst that disease may rage in one town, and another town situate lower down the same stream, and using the contaminated waters for domestic purposes, may entirely escape. Cholera has also not unfrequently been known to work up a river, instead of following the current. Such facts as these, I submit, ought not to be entirely overlooked in speculations on the spread of zymotic disease.

But to return: if disease-germs, when once in a river, cannot be destroyed, the question remains whether such germs, if present in sewage, can by any mode of treatment be kept back. Dr. P. Frankland made the honest admission that "there is absolutely no evidence that morbific matter, if present, would be removed" either by irrigation or "downward intermittent filtration." He even stated that, "On the contrary, there is very strong reason to believe that these processes of purification offer no sort of guarantee that noxious organised matters present in the sewage may not pass through into the effluent. For the removal of organic matter by means either of irrigation or intermittent filtration depends upon the oxidising action which a porous soil exerts upon such matter, and is quite analogous to the purification of water percolating through a few feet of soil into shallow wells. Now, the instances on record of the percolation of sewage into shallow wells becoming the means of infection are so numerous and well authenticated that it is unnecessary for me to refer to them here. . . . At Stuttgart in Germany, and Winterthur in Switzerland, some years ago, epidemics of typhoid fever were proved most conclusively to have been caused by the contamination of the water-supply with the effluent from irrigated meadows." Dr. Jabez Hogg cited the well-known case of a stream in

Switzerland which soaked through an entire mountain of oolitic rocks, yet on emerging into another valley was found to have brought with it the infection of typhoid fever.

The present writer has seen flocks of sewage fungus along with the effluent from a large, fairly deep, and well managed sewage irrigation farm. Surely, then, it may be contended that the main ground for the alleged superiority of sewage-irrigation to precipitation processes is substantially abandoned by the above-quoted admissions of Dr. Percy Frankland. He, indeed, argues that if filtration cannot remove disease-germs, so *à fortiori* cannot precipitation—a mistaken inference. There is, in the first place, no evidence that the proportion of organic matter in water bears any constant ratio to the number of disease-germs which it may contain.

If we accept to the full the germ theory we must admit that if the dejecta of a single cholera or typhoid fever patient be thrown into a pure mountain stream, the effect upon the health of a community lower down will be more serious than if the sewage of an entire village had been poured into it. Hence determinations of organic nitrogen and organic carbon, and "previous sewage contamination," throw surprisingly little light upon the safety or danger of using a stream as a domestic water-supply.

But there are facts which prove that precipitation processes—all those at least which employ aluminous salts as precipitants—are not less, but more effectual, guarantees against the presence of disease-germs than any filtration or irrigation process.

For centuries it has been customary in China to add to suspicious and polluted waters a pinch of alum, strain off the clear liquid after standing for some little time, and use it for drinking or cooking. For some years the French troops in Cochin China suffered severely from dysentery of a very malignant kind. It was observed at last that if this Chinese expedient was used persons drinking the water escaped the disease. The microbia are not necessarily killed, but are precipitated and remain in the sediment.

So decisive is this reaction that Dr. Brautlecht has introduced it as a means of detecting bacteria, &c., in waters. He makes a solution of sulphate of alumina, acidulates it with hydrochloric acid, and adds a few drops of this liquid to the water he is about to examine. A few minutes afterwards he adds cautiously a few drops of ammonia, so as to neutralise the whole. A precipitate is formed which carries down with it the bacteria. It is filtered off, re-dissolved in

a little acetic acid, and thus presents the microbia, if any, collected together in a small bulk of liquid. This process is substantially what is done in the A B C process, the other ingredients having different duties to perform. If, then, Brautlecht's method is worth anything, effluents which have been treated with an aluminous salt are much more likely to be free from bacteria than is any filtration effluent.

It is a remarkable and instructive fact that the majority of those authorities who in former days denounced sewage-precipitation in general, and the A B C process in particular, have been led, on further observation and reflection, to modify their views. Is the ghost of the Rivers' Pollution Commission to form the only exception?

It must be noticed that I do not enter into the general question whether the Thames is an eligible source for the water-supply of such a city as London. If it can only be made so by the entire exclusion of sewage, purified or raw, either the use of water-carriage for human excretions must be totally stopped along its course, or a large proportion of its water must be cut off. Dr. P. Frankland, though his wrath seems mainly directed against the A B C process, yet admits that the drainage from cultivated lands, manured as they often are with human excrement, is a source of danger.

But suppose that the Thames is abandoned as a water-supply, and that in its stead we have a gigantic aqueduct, bringing an artificial river of soft water from the mountains of Wales or Cumberland, or even from Scotland,—will, in this case, all danger to public health be removed? Mountain waters often contain traces of lead, and soft waters—such as are used in certain towns of the north of England—act upon the lead service-pipes to such an extent as to be dangerous. Constant lead-poisoning would be, I submit, fully as serious an evil as an occasional outbreak of typhoid fever.

IV. JOTTINGS IN SOLAR PHYSICS.

By A. H. SWINTON.

ASTRONOMERS have long noticed that one half of the sun's face is frequently very much more spotted over than the other half, so that as it rotates on its axis every twenty-five days and a fraction the spots turn towards and away from our globe, much as a revolving light blinks out its warnings to the mariner at sea. If, then, the sun-spots indicate progressive changes transpiring in the luminous disk of the sun, and revealed to us in the writing of the magnetograph, and if these changes are in any way connected with the amount of light and heat emitted by the disk of the sun, we should then certainly expect to find these sun-phases mirrored in the terrestrial phenomena which surround us. At the commencement of last spring I devoted considerable attention to watching the sun's disk, and noted down carefully these minor times of spots and no spots, which with the telescopic power employed appeared to be of very unequal duration, although it is not at all improbable that they ran through their appointed cycles and periods. Thus when I began my diary at the end of January I observed no spots. One solitary spot came round on the left of the sun's disk on February 1st, and inaugurated a period of sun-spottiness that terminated on the 21st of the month. The sun's disk then appeared clear until the 25th, when some spots came round again. They continued visible till about the 28th, when they were on the point of disappearing round the right side of the sun's disk. Then ensued a period of no spots that lasted until March 8th, when the great army of spots was round again. They did not disappear until after April 24th, so that at this time it would seem that the *entire superficies* of the sun was spotted over. For a brief period, from April 29th until May 5th, I observed no spots.

We then have apparent times of sun-spots, indicating hidden phases of the sun, that doubtless have their cycles and periods. In connection with the times of spots and no spots I noted down any sudden atmospheric changes and any record of earthquake shocks I met with; and here, I think, I fairly detected a coincidence. Thus on February 28th, when the spots were on the point of disappearing,

news came of earthquake shocks having been felt in New England at several points; and on March 5th, just previously to the phase of sun-spottiness, there was a severe shock of earthquake felt throughout Cyprus. Between April 29th and May 5th I observed no sun-spots and remarked no earthquakes, nor do I think that they were prevalent the first week in August, when I observed but one small sun-spot. During the great seismic calamities of the year I conclude the superficies of the sun was much spotted over, but I did not detect that the appearance of spots of large size or great groups was in any way directly connected with the record of earthquake disaster. However, if these few imperfect observations be of any real weight they would point to the fact that we have, working at observatories, magnetographs, which either record the minor sun-phases or the energy of the spots on the sun's disk; and the inference is that these instruments might be found to be writing down warnings of disaster could we only read the sudden dashes and long lines.

Mechanical laws regarded as constant, and a statical condition assumed, the rudiments of Physics render it evident that changes in the heat of the sun must cause the surface of the globe on which we live to expand and contract, inasmuch as a milk jug chinks to the frost or the embers crink as the fire subsides.

Again, terrestrial laws considered uniform in operation, a sudden access or diminution in the heat received from the sun should likewise modify the fluctuations of the atmosphere and currents of the ocean, and these modifications, according to the statical law of fluids and the theory of displacement, should be universal, inasmuch as when a fire is kindled draughts arise from all quarters of an apartment, or as water when warmed commences to eddy. Sometimes it indeed would appear that, *whether* from the direct rays of the sun or from an influx of a current of heated air, the sun-spots associate themselves with a spell of abnormal heat, as was the case last year from June 28th until July 4th; or again, in regard to the heat-wave that passed over England between the 6th and 8th of October.

During this brief and genial Martinmas summer the male starlings at this place were deceived into renewing their rattling Hymenean calls, as if Spring had already breathed over the land, and every chimney-top and high branch had its noisy chorister. I likewise noticed the following meteorological coincidences:—The barometer rose when the spots disappeared from the disk of the sun on

February 21st, and when they disappeared on April 28th the weather—after having been cold and chilly for a week—turned suddenly warmer. The Java eruption, singular to say, coincided with a spell of warm weather in this country, which commenced on August 17th and broke up on the 29th. It is singular that working meteorologists should hold a difference of opinion as to whether the sun is hotter or colder when it is spotted over, as this causation is the source of all solar physical theories: from the naturalist's point of view it should be, I think, with little doubt, colder.

Mr. Norman Lockyer, a little time ago, informed us that an examination of the percentage of total wreckage, posted on the loss-book at Lloyd's, showed that between 1856 and 1876 most vessels had been lost at the times of maximum sun-spots, and it appears that a return recently issued and made public in the daily papers greatly confirms this statement. It shows that there has been a decrease in the number of sailing vessels wrecked, commencing with the year 1874 and ending at the year 1878, when sun-spots were fewest, and a corresponding increase commencing with the year 1878 and ending at the year 1882, when sun-spots were at a maximum. For example, in 1874, 214 sailing vessels were lost at sea; in 1875, 167; in 1876, 154; in 1877, 156; in 1878, only 129; in 1879, 140; in 1880, 132; in 1881, 205; in, 1882, 194; in 1883, 163. As these statistics involve a large factor in regard to the sacrifice of human lives, it might suggest that a law should be enacted regarding the over-freighting of vessels when perils are so imminent. It would seem here the rule that at the sun-spot maxima about *twice* the number of sailing vessels have been lost. The *local* wreck chart, of *our coast* of course, gives less precise statements; it shows that between 1854 and 1882, as far as I gather, there have been fewest wrecks between the two opposite sun-spot phases, and most at the two epochs,—a matter which has doubtless affected insurance, although the chapter of accident has been fairly represented. On the other hand, it has been remarked that at the sun-spot minimum, or during the years 1877 and 1878, there was an increased loss of life in mines in the United Kingdom, without doubt owing to an increased emission and accumulation of fire-damp under certain atmospheric conditions.

In the commercial centres of the United Kingdom the economical aspect of Solar Physics is felt to be of moment, and there exists an unquiet feeling in respect to how much is to be believed and how much discredited. Quite recently a north-country daily paper undertook to review the

Government "Blue Book" on the subject, the misconceptions of the compiler being used as an argument against the endowment of research. "How is it," asks the reviewer, "that a year exceptionally *wet* in Britain was exceptionally *dry* in Mauritius? At Calcutta, the rainfall in the maximum year *was very considerably* less than in *either* of the minimum years, while at a large number of stations the year *after* the maximum was *wetter* than the maximum year itself." The answer to these arguments evidently is, there never was a general rule without local exception. As a point in fact the writer states that the heaviest British rainfalls in the century have been in 1852, 1866, and 1872, quoting the "Astronomical Register" for August, and he enquires how any phase in the sun-spots is here indicated. At the outset, however, this is evidently a manifest discrepancy with Symon's Table of British Rainfall, which gives 1852, 1860, and 1872 as the wettest years. But in reality both quotations must be qualified, since the rainfall diagram requires to be equalised in the same manner as the chart of magnetic variation before the causation can be properly seen; and when this is accomplished it then becomes very palpable that there has been during the present century a rise at the maximum of sun-spots, and a supplementary rise, more or less pronounced and less in degree, at the minimum. For instance, a maximum of sun-spots occurred in 1848,—or more properly between the years 1847 and 1848,—and in 1848 and 1852 the rainfall was excessive, so that the effect of the sun-spots may be traced continuously from 1847 until 1852, as is seen also in the chart of Greenwich declination. The next epoch of sun-spots was in 1860, the rainfall of 1866 being accredited to the succeeding minimum; and the next in 1870. The rainfall of the later epoch, however, did not commence until the following year, and it attained a maximum in 1872, while the magnetic declination at Greenwich reached a maximum during 1870, and continued until 1872. What is *wanted* is men *of* various endowment.

V. HYLOZOISM AND HYLO-IDEALISM.

By C. N.

"The question of the *anima mundi* and *anima hūmana* is at bottom one and the same. . . . If matter acts by means of its own *vis insita*, and depends on no extraneous influx, or impulse, the whole problem of Immaterialism and Materialism, Supernaturalism and Naturalism, is solved in favour of the latter."—*Life and Mind on the Basis of Modern Medicine*, by ROBERT LEWINS, M.D.

"The philosophy of the earlier Ionic physiologists is Hylozoism,—*i.e.*, the doctrine of the immediate unity and matter of life, according to which matter is by nature endowed with life, and life is inseparably connected with matter."—UEBERWEG'S *History of Philosophy*.

THE blind Galileo lamented that he who had peopled the visible heavens with new worlds, and widened by well-nigh unimaginable spaces the boundaries of the known Universe, should now be imprisoned in the dark and narrow limits of his own bodily frame. It was a pathetic complaint, and not pathetic only, but significant of that genius which in the noblest intellects has power to unify Science with Philosophy and with Poetry. To Galileo discoveries were creations. The moons of Jupiter did not exist for the human race till revealed by his telescope; the myriad stars of the Milky Way were mingled in an indefinite haze, until, seen through his "optic glass," they started into bright distinctness.

What is unknown and unconceived is virtually unreal. "Let there be light" is a useless mandate unless there are eyes and a brain which can translate stimulus into sensation, and extract colour and form from hueless and formless impulses. Yet the mighty astronomer spoke only a partial truth. The loss which he mourned was in reality the loss of an inner, not of an outer, world; for the keenest vision of the most sublime intellectual exaltation could never have enabled him to transcend the limits of his own mind and his own organism. The God within had been robbed in part of his creative power. Sounds and scents and tastes and touches were still produced in the Microcosmos, but the source of light was extinct.

The successors of Galileo have not attended to this lesson. They terrify us with material vastness and splendour. They bid us contemplate astronomic cycles, which can indeed be measured, but can never be comprehended; vast, cold, black

stretches of interstellar space; suns tenfold, twentyfold, a hundredfold more brilliant than ours, whose light travels earthward through decades, centuries, or millennia. Then they point to a drop of dirty water, crowded with swiftly darting animalcules, and tell us that the Earth, in comparison with the Universe, is infinitely smaller than that drop in comparison with the Earth, and that we and our individual and national concerns are thus of incalculably less relative importance than the family life and polity of *Rotifera vulgaris*. To all this we have listened *ad nauseam*. We are beginning to reflect that majesty which may be measured by a foot-rule is a cheap kind of majesty after all, and that the exultation of popular lecturers in the sublimity of the Cosmos (which they seem to consider their own private and exclusive domain) is a little like the pride of a Limited Company in the ownership of the largest gasholder in the world. We feel inclined to retort—Call us Rotifers if you will; but remember that we are Rotifers who can perceive our environment, and that until perceived this environment is void, unshapen, and altogether null. Were the rotiferal consciousness capable of shaping forth the orbs of heaven, the consciousness would be superior to the orbs. It is true that our spheroid home makes a short circuit through space, and that the comet of 1811 makes a long circuit. It is true that the glory of Sirius surpasses the glory of our sun; but light unseen and unthought is not light, and Sirius owes his splendour to the human imagination. Every man fashions and contains a Universe; and it is at least difficult to understand why the importance of the mind should be in inverse ratio to the magnitude of its contents. To be cowed before our own mental furniture is to resemble the mushroom millionaire, abashed by the size of his new house and the magnificence of its carpets and mirrors. Let us imitate neither his first bashfulness nor his subsequent brag, but learn to move easily about our mansion, as if to the manner born.

Since the days of Copernicus, Kepler, Galileo, Newton, we have nearly had time to grow accustomed to our surroundings. Mankind begins with Geocentrism, passed onward through Heliocentrism to the conception of an uncentred Universe, and must now reconcile their conflicting impulses in Autocentrism. The Geocentric ideal was narrow and mean. The small parish of Earth regarded other regions of the Empire as minor adjuncts to its own glory, and the local King was popularly supposed to rule in accordance with this notion. Heliocentric and Acentric ideals

were wider, but cold, comfortless, incomplete. Earth now became a part of heaven; but it had been weighed in the balances and found wanting, and there was an end. Nothing was said about forces which could not be expressed in units of gravitation. One throne of the village monarch became uncertain, and his policy doubtful and inconsistent.

The Autocentric ideal is wide and lofty as thought, clear and vivid as sensation; for sensation and thought are the ultimate standards to which we can appeal. A world-wide Self governs the new Empire. The former King is now recognised as a subject; nay, as the offspring and semblance of the rightful lord. As fire and steam and electricity have been tamed to the will of man, and changed from foes to servants, so the awe and self-contempt and shuddering sense of insignificance once inspired by the broadening of the heavens is now reversed, and made to enhance a thousandfold the sense of human dignity.

This is an illumination which cannot be wholly rejected even in the present age of speechifying and specialism, of mystical mathematics and transcendental chemistry. Scientific theorising, indeed, has its appropriate and worthy place. It is valuable as subserving either practical use or philosophic truth, which in its turn aims to be the minister of daily happiness. Special researches must doubtless be pursued by many who will never be able to connect their theories with larger generalisations, and who are from that very cause all the better theorists on their own ground; but there is no reason why the minds of such intermediate workers should not be exalted by the feeling that their particular lines of operation may converge towards the highest point of thought, and reinforce the divergent lines issuing thence to the broad plane of action. The artist who decorates the altar with inlaid marbles could not plan the cathedral, but he knows that his work is to be a harmonious part of the general design. The station-master must not fancy that the terminus of the line is, or ought to be, at his little country town. He may never visit the great city himself, but the very fact that there is a great city which he helps others to visit should exercise some widening influence upon his mental horizon.

Physiology teaches that without sensation there is no soul, and that without specially organised matter there is no sensation. It further teaches that the world, as we know it, is composed of sensations variously combined, and is produced within that "crumpled pocket-handkerchief" called the cerebrum. And on this seemingly narrow

foundation must be built whatever philosophy the future has in store.

With that which lies beyond thought and perception we can have nothing to do; nor can we have very much to do with thoughts and perceptions which shine dimly through long spaces of years. As well might we feign that the light of some distant star, reaching us after a journey of two millennia, is the guide and strength of our life. If it be true that the worth of human conduct consists neither in its somatic or spiritual source nor in in its finite or infinite duration, but in its own intrinsic quality; that man has made God in his own image, and worships only Self; that all knowledge of others is a form of self-knowledge; and that all sympathy is based not on mere kinship, but on real solidarity—if this be true, it is clear that we have the outlines of a system which is no mere speculative philosophy, but must affect every relation of practical life. And the validity of this system admits of support or illustration from every department of Physical Science.

Let us glance along any one of the lines which radiate from the democratic substratum of questionable shapes, neither wholly animal nor wholly vegetable, and bear, as their crowning product, some highly specialised aristocrat. As the line passes upward new qualities appear,—sometimes so suddenly that there is a temptation to invoke supernatural agency, and to account for the Inexplicable by ascribing its origin to the Unthinkable. Yet, looking closer, we see that there is no attribute of man or of imagined angel which has not its quaint parody in a lower rank of being. Human volition and the "little living will" of the Nautilus differ in degree, in power, in variety of manifestation; but the difference is specific, not generic. The decorated assembly-halls of the Australian bower-birds are not more distinctly related to the artistic achievements of man than is the whirling dance of the *Rotifer* to the manifold activities by which man earns a living.

But there is a class of phenomena even more worthy of note than these traces of family likeness, even more instructive than direct evidences of a common line of ancestry; because a certain section of the class has been selected by Dualists as the basis of their strongest argument. "How is it," they triumphantly enquire, "that personal identity persists through the constant flux of molecules; that the man who daily dies by inches, and is in like manner regenerated, feels himself to be the same man from month to month, and from year to year? How is it that he remembers

past actions, performed by muscles and directed by a brain of which not one cell or fibre now remains intact?" These questions certainly cannot be answered, but a practical refutation of the suggested inference may very easily be found.

The phenomena of personal identity form by no means an isolated group, and do not testify to anything anomalous in the position and nature of man, or of any other conscious being. This survival of self amid the daily decay and renovation of its physical basis is but a special case of that persistence of function amid mutations of matter on which depends the reproduction of individuals, varieties, and types.

The elm puts forth every March its green clusters of flower-buds, protected by brown scales. It never varies very widely from the fashion of colouring and grouping observed by its ancestors for generations back. Purple-tipped perianth, purple-tinted anthers, cleft stigma with delicate crimson fringe—all are according to tradition. Advocates of the old "*emboîtement*" theory had a very convenient way of accounting for such facts as these: they held that the unfertilised ovule already enfolds in miniature every part of the perfect tree—trunk, branches, leaves, flowers, and fruit; and that the animal or plant cannot develop a scale or a hair which was not latent in the embryo. Growth, they said, is simply the absorption of nutriment. The change is not in form, but simply in size. Moreover, every germ is indestructible, and has endured from the beginning of the world. It contains all its progeny down to the end of time, and was itself contained in its remotest ancestor.

This plausible though baseless hypothesis, it will be noted, "explained" the riddle of personality as well as the riddle of heredity. Body and brain were moulded on an extensible framework, gradually distended during the period of growth, and gradually collapsing during the period of decay. There was an outline to be filled up and overlaid with divers colours; and when all these were washed out the original sketch still remained. The idea, though of course long ago discredited, had at least one merit. It showed some appreciation of the connection between two sets of facts, usually considered apart. The problems suggested by transmission of family traits, and by preservation of individual traits, are substantially identical; and since the soul-theory fails to suggest a *rationale* of the former, it can no longer be applied to the solution of the latter. When we know why the man is the father of the child, we shall also know why the child is the father of the man.

Descending from the organic to the inorganic world, it may seem at first sight that nothing analogous is to be expected. Yet if the body of man be modelled by an indwelling spirit, the presence of a similar architect is surely required to account for the structure of a crystal. The crystal, indeed, does not *exchange* particles with the surrounding medium; it does not assimilate or excrete. Yet it is able to preserve a virtual identity amid material changes. Fracture it, and suspend it in a saturated solution of the same or an isomorphous salt, it attracts the kindred molecules, repairs the injury, and grows to an enlarged likeness of its former self.

But the generalisation which I have tried to indicate admits of a far wider statement. Phenomena such as growth, reproduction, crystallisation, in which the primitive form is (with some variations) preserved or renewed, are only special instances of the operation of an evolutional energy, universally inherent in Matter. From its analogy with human action, the part which this energy plays may be described as *purposive*, and its manifestations are to be sought wherever function determines structure,—that is to say, wherever similar properties, belonging to bodies which may in other respects be like or unlike, produce similar results. The force which induces sodium to combine with oxygen, or hydrogen with chlorine, and permits the combination only in certain definite proportions, is as truly architectonic as the force which evolves the embryo from the germinal vesicle. Kepler believed that the planets were guided in their elliptic orbits by angelic pilots, and the idea was worthy of an age which installed a separate spiritual Archæus as president of every organic function. But we now know that the Angel which moulds, moves, and directs each planet can be none other than the inseparable energy which inheres in every atom of its mass.* Shall we demand any other Angel as Archæus of the human brain? The monarchs of heart, liver, and stomach have long since been consigned to oblivion.

We have now traced along two distinct lines of argument the essential unity of man with his environment. We have seen that he is the procreator of the phenomenal world; that, by a wondrous alchemy, the delicate cells of the cerebral hemispheres convert stimuli into sensations, and combine sensations into perceptions; that in his mind the

* "Our great English geometrician, by his discovery of universal gravitation, was the real founder, in Christian times, of scientific common-sense Materialism."—*Life and Mind*, p. 13.

visible and tangible Cosmos lives and moves and has its being. We have seen, also, that the real or noumenal world is everywhere alive with the same architectonic activities which culminate in the human Ego; and that the formative "Spirit" is a purely material energy, not less necessary to the sand-grains of the sea-shore than to the molecules of the cerebrum.

V. ON SELF-MUTILATION IN THE LOWER ANIMALS.

IT is maintained that a rat if caught by the leg amputates the limb with its teeth, and escapes. We have heard the same thing said concerning wolves. We have been told by a friend that in the Orange Free State he went out one morning, in company with a Boer, to inspect a trap which the latter had set for some plundering baboons. On coming within sight they found that one of the tribe was caught. Thinking him secure they approached very deliberately, and were surprised at seeing the animal suddenly wrench himself away and disappear among the rocks, leaving, as we were told, a part of his leg in the trap. We cannot guarantee these statements, and we have strong doubts whether any warm-blooded animal—especially one so near of kin to man—could survive so rough-and-ready an operation. It is, however, a well-known and common fact that animals belonging to various groups occasionally perform a mutilation of some of their members in order to escape from an enemy. We know that the blind-worm and the lizard can break off their tails, and that a number of crustaceans, spiders, and insects if caught by a leg throw it off and flee. How readily this is done by that corn- and grass-destroyer the crane-fly, or daddy-longlegs, is a familiar circumstance. Many observers must have seen this insect leave in this way a leg in the web of a spider, and have noted the evident surprise of the latter on finding a limb without a body. It is also on record that an *Epeira*, the well-known geometrical spider so common in our gardens in the autumn, having

been bitten in the foot by a *Tegenaria*, amputated the envenomed member.

Such cases of self-mutilation have been of late carefully studied by M. Léon Fredericq, especially as regards crabs. The results of his interesting observations have been made known in the "Archives de Zoologie Experimentale," and in the "Naturforscher."

He establishes, in the first place, that this process of mutilation is performed in the same manner on any leg, and, if it so happen, on every leg of one and the same animal in succession. The fracture always takes place at one and the same part of the leg, in the continuity of the second joint, counting from the body, and leaves a rounded sharply-marked surface. This part is by no means characterised by unusual fragility. On the contrary, the leg of a dead crab possesses a great power of resistance, and bears a strain of several pounds without giving way. When actually broken it has an uneven surface, and the fracture scarcely ever occurs in the continuity of the second joint.

Experiments on the conditions in which the living animal throws off its leg prove that a fracture is effected at the point in question by an energetic muscular contraction. The limb is invariably broken off if the nerve of sensation of the leg is strongly irritated. M. Fredericq found it possible to induce self-amputation by applying a mechanical irritation to the sentient nerve of the leg at a more peripheric point. If this irritation is less marked, as for instance by gradual section of the leg, the animal does not react by self-amputation. If, however, the end of the nerve thus exposed is moistened with alcohol, the crab replies to this chemical irritation by an amputation at the second joint. If the leg is heated the thermic irritation at once produces a fracture at the same place. It was also found very easy to bring on amputation by applying electricity to the nerve. These last experiments permitted a measurement of the time. It was found that the interval between the irritation of the nerve and the rupture of the leg is very variable, ranging from a few hundredth parts of a second to an entire second, and even more.

After these experiments had sufficiently proved that the amputation of the legs in crabs is a reflex process, M. Fredericq endeavoured to ascertain the nerve-centre which is the seat of the mechanism. The removal of the ganglia of the throat had no influence on the phenomenon. But if the ventral ganglia were destroyed the reflex mechanism was annulled. The entire leg might then be cut off without

inducing self-amputation. The direct application of electricity to the ventral ganglia induced in one case the amputation of a leg.

These experiments prove that the self-amputation of the legs of the crab is a purely mechanical process, in which the will of the animal is nowise concerned. This is still more clearly proved by the following experiment:—A captive crab, held fast by one leg, will exert himself to escape until quite exhausted, without ever coming upon the idea of escaping by throwing off the leg. If, however, the limb in question is pinched, or if the nerve of sensation is irritated in any other manner, the fracture ensues at the usual point.

Lastly, M. Fredericq has sought out the last remaining link among the organs concerned in this strange process,—the muscles whose action mediates the fracture. He found that the integrity of the extensor muscle of the second joint is the essential condition for effecting the fracture. It is also necessary that the leg and the distal extremity of the second joint should find a resisting fulcrum,—either the finger of the experimentalist or the shell of the animal itself.

It must still be noted that this reflex amputation is never attended with loss of blood, probably because the muscle which effects the rupture remains contracted.

M. Fredericq has observed such self-amputations in the lobster and in various crabs, in the hermit-crab, the shrimp, &c.

Subsequent observations made by M. Fredericq on a blind-worm have convinced him that the shedding of the tail is effected here also by muscular contraction, and does not depend on any fragility of the part, as the name *Anguis fragilis* would seem to imply. To a dead specimen which weighed only 19 grms., a weight of 490 grms. had to be appended in order to tear off the tail. If a living blind-worm was suspended with its head downwards it twisted about in various directions, but without escaping by breaking off its tail; but if the end of the tail was strongly irritated a series of lateral movements took place below the point of suspension, with the final result that the tail broke off, whilst the animal fell to the ground and fled.

It was again caught and suspended by the stump of the tail. If the stump was rubbed with the fingers the animal broke off again immediately below the point of suspension, by the same mechanism of alternating contractions to the right and the left side of the body. Hence it appears that, just as in the case of the crab, we have an active fracture—

a muscular movement of a reflex character, induced by irritation of the sensient nerves of the tail. The phenomenon differs, however, in one respect, in the crab and in the blind-worm. In the former the fracture is effected at one only point, whilst in the blind-worm several pieces of the tail may be thrown off in succession.

The portions thus amputated by the animal retained for more than ten minutes an alternating lateral movement to the left and the right. These movements ceased at once if the spinal cord was destroyed, but otherwise became gradually fainter and ceased, but reappeared on irritation. Microscopic examination showed that the fracture took place in the level of the sinews, and never in the contractile substance of the fibres.

Experiments with a lizard, several spiders, and insects convinced M. Fredericq that these animals display the phenomenon of an active self-mutilation.

[Without questioning the accuracy of the observations of M. Fredericq, and of the conclusions based upon them, we must be permitted to doubt whether the latter are applicable to all cases of self-mutilation. On two occasions we have seen a *Tipula oleracea* fall into a cobweb, and escape with the loss of a leg. Here there was no irritation applied to the foot, and the leg yielded merely to "a long pull, and a strong pull, and a pull altogether," just in time. The case of the *Epeira* is open to doubt. The observer thought that she was intentionally amputating the leg lest the venom should extend up to the body; but it is possible that the irritation of the bite of the *Tegenaria* may have led to a reflex fracture. It is said that lobster-fishers dread a thunderstorm, as the captive lobsters sometimes shed their claws. Is this assertion capable of being verified? If so it does not agree with M. Fredericq's observations, since the action, though doubtless reflex, is not due to any irritation of the limb below the point of fracture.]

VII. ON THE MECHANICAL RECEPTION OF NUTRIMENT INTO THE INTESTINAL MUCOUS MEMBRANE.

IT has long been known that the assimilation of nutriment in those groups of Protozoa which are destitute of a mouth, or an oral opening, is thus effected: the body, consisting of "sarcode" (protoplasm) emits pseudopodia, which seize upon the particles of food, surround, and imbibe them. In each of the pseudopodia there can be observed a double current of the protoplasm—a centrifugal and a centripetal.

Until recently this mode of taking up nourishment was supposed to be confined to the Protozoa, whilst certain and trustworthy observations were wanting as regards the Metazoa. Latterly, however, some exceedingly interesting results have been obtained concerning the Cœlenterata.

Both in the Sponges and in the true Cœlenterata nourishment is taken up essentially in the same manner as in the Protozoa,—the only difference being that here, in accordance with the division of labour characteristic of the body of a Metozoon, this process is carried on within the region of the endoderm.

The cells lining the nutrient cavity possess, like the entire body of the Protozoa, an active amœboid mobility,—*i.e.*, they retain, to a certain extent, their individuality as independent elementary organisms, and they flow round and envelope the particles of nourishment by means of their pseudopodia, exactly in the same manner as do the Protozoa. This power belongs either to the cells of the entire endoderm, or it is, in other cases, limited to certain regions.

The question now arises whether this method of intercellular digestion extends also to types higher than the Cœlenterata. This, according to the researches of a series of investigators, is actually the case. Thus, in the first place, the amœboid movements of the intestinal epithelium were directly observed in the *Turbellaria*, animals of a very low rank.

Subsequently it was found that numerous *Turbellaria*, whether possessing an intestinal canal or not, take up their nourishment direct into the parenchyma. But not all

Turbellaria display this intercellular digestion. There are some whose intestinal cells have completely lost the power of taking up nourishment,—a fact which is also recognised in the *Rotatoria*, the *Annelides*, and many other worms.

As in the remaining evertebrates—*e.g.*, in the arthropods and the mollusks—nothing has been as yet ascertained concerning intercellular digestion, we might incline to the assumption that the above-mentioned pristine method of taking up nourishment has not been inherited beyond the worms, and that the intestinal epithelium has lost its amœboid character, and has become to a certain degree consolidated along its free margin. We might be disposed to view the strongly refringent basal border, recognisable in the intestinal epithelium of most mammals, as such a solidified outer zone. As regards its more intimate structure various views have been suggested, which, however, by no means fully explain the reception of nourishment as it occurs in the intestine. On this subject the following facts are known :—

The molecules of fatty matter can be traced directly on this passage through the body of the cells. As regards the reception of the albumen we had no definite ground for asserting an active participation of the cellular protoplasm as it takes place in the above-mentioned evertebrate animals. It was therefore assumed that albumen was taken up by means of processes of diffusion and filtration. Although the diffusive power of soluble albumen is too low to explain its necessary abundant transmission into the blood, yet the peptones possess a diffusive power fully sufficient to meet the necessities of the case.

As regards the mucous membrane of fishes and amphibians, Dr. R. Wiedersheim (" Naturforsch. Gesellschaft zu Freiberg," and " Naturforscher ") has observed certain facts which are not unimportant in their bearing on this question. The intestinal canal of those vertebrates which are regarded as phyletically the oldest—the *Amphioxus* and the *Cyclostomi*—are completely devoid of pepsine glands, and here, consequently, the formation of peptones is entirely out of the question. The question therefore arises whether here, where a stomach is entirely excluded, there exist in the intestinal mucous membrane arrangements which—in contradistinction to what holds good in the higher vertebrates—permit the absorption of unmodified albumen. The following facts, observed by Dr. Wiedersheim, may pave the way to a direct reply to this question.

In 1875, during an anatomical examination of the cave newt (*Spelerpes fuscus*) he observed in the intestinal canal large extents of ordinary epithelia, which in recent preparations displayed no basal margin. These free borders appeared to him devoid of sharp limits, irregularly ragged, and resolved into fibres. The protoplasm on the free margin of certain cells was engaged in an active amœboid motion. He distinctly observed slow changes of form in the cell-processes, and twice he saw those processes retracted into the body of the cell.

Dr. Wiedersheim further succeeded, when examining living sharks, in confirming an observation of Edinger. The latter found in the mucous membrane of the intestine of fishes a large mass of lymph cells, which even penetrate between the experiments. He further succeeded in proving, by means of experiments with chopped meat, mixed with graphite, that these lymph corpuscles took a distinct black colour. He even believes that he could here and there recognise the black pigment in the interior of single epithelial cells. Hence he considers himself justified in concluding that the intestinal epithelia of fishes, like those of *Spelerpes fuscus*, are capable of amœboid movements.

Although Dr. Wiedersheim has not succeeded in directly feeding the epithelial cells of fishes with granules of pigments, he is still of opinion that both the lymph cells of fishes and the epithelial cells of newts subserve a mechanical absorption of nutriment. The active amœboid movements of the intestinal epithelia have been fully established in vertebrate animals, as well as in many evertebrates. This amœboid motility of the cells he regards as a primeval heir-loom from the lowest vertebrates. He does not, however, deny that with the decrease of the individual activity of the single cells their universal mechanical power of taking up the most varied kinds of nutriment declines in vertebrate animals, and this the more as the chemistry of digestion begins to play a more important part in consequence of the development of different kinds of glandular apparatus. In other words, we have seen that the original method of taking up nourishment was purely mechanical, depending on the active intervention of the cell itself. This naturally does not exclude a true intercellular chemical assimilation.

In the higher vertebrates—*i.e.*, from the osseous fishes, and perhaps even from certain *Selachii* upwards—the

intestinal epithelia lose the power of taking up solids. In these protoplasm processes of differentiation must appear in virtue of which they appear adapted solely for taking up certain determinate matters which have undergone chemical modifications. In short, the simple cell now, like the cells of glands, displays a selective power with referenec to the matter to be taken up.

This view must be capable of experimental conrfimation in those vertebrates whose intestinal canal is devoid of complex glands, as in *Amphioxus* and in the *Cyclostomi*.

ANALYSES OF BOOKS.

Geology of Wisconsin. Survey of 1873 to 1879. Vol. I. Published under the Direction of the Chief Geologist by the Commissioners of Public Printing.

THE liberality with which both the Federal Government and the Governments of the various States of the North American Union distribute the elaborate reports of their surveys and explorations deserves the warmest recognition from the *savants* of all nations. The volume before us consists of three parts, treating respectively of the general geology, the natural history, and the industrial resources of Wisconsin. For the present we shall confine our attention to the second of these sections.

Its first chapter contains analyses of the principal limestones, sandstones, crystalline rocks, clays, soils, and native waters of the State. One of the latter, the Bethesda Spring at Wankosha, presumably free from human contamination, contains the large proportion of 1·983 grains of organic matter per gallon. The minerals and rocks are next enumerated and described, and are followed by a very elaborate catalogue of the fossils.

Next follows the local flora. Turning to the ferns here mentioned, we find a greater proportion of species which Wisconsin has in common with Britain than occurs in most other orders. Thus the common brake, the polypody, the "female fern," and the royal Osmund are as decidedly native in Wisconsin as with us.

In the Lepidopterous fauna we find a larger proportion of diurnal species, the Rhopalocera, common to both sides of the Atlantic, than we do of the Sphingidæ or hawk-moths. This is exactly what we should not have expected, *à priori*, if we take the great strength and swiftness of the latter group of insects into account. We rather demur to the statement that all the hawk-moths are decidedly noxious, as a very large proportion of them feed upon plants which are not objects of man's care and cultivation.

Among the Noctuidæ we notice the great development of the genus *Catocala*, to which the beautiful "red underwings" belong. Of this genus 27 species have been taken within two miles of the town of Racine!

In Chapter IX. Dr. Hoy gives an important catalogue of the cold-blooded Vertebrates of Wisconsin. There are only three lizards. The non-venomous snakes are numerous. Two poisonous

species only are mentioned,—the yellow rattlesnake (*Crotalus durissus*) and the massassanga (*Crotalophorus tergemina*). We cannot agree with Dr. Hoy when he pronounces the Crotalidæ the most deadly poisonous serpents known.

Mr. M. Strong gives a list of the mammals, in which the diet and habits are tersely summarised, and an opinion is given as to whether they merit preservation or extirpation. Most of the squirrels are shown to be decidedly harmful, as destroying corn and eating the buds of trees.

Mr. King furnishes a very instructive chapter on the "Economic Relations of Wisconsin Birds." This report is founded on an examination of the contents of the stomachs of over 1800 birds. "The contents of one-half of the stomachs were examined under the hand-lens on the day they were obtained, while the contents of 750 were transferred at once to small phials containing alcohol, and carefully labelled." This material, by the permission of Prof. Comstock, was studied in the Entomological Laboratory of Cornell University. The author lays down the following preliminary propositions:—A bird renders a service when it is injurious or destructive to plants which are to be regarded as detrimental. Mr. King, indeed, considers that the mere act of cultivation so effectually controls these weeds that but little work is left for birds to do. We can scarcely accept this in view of the persistence, if not the increase, of many of the more noxious weeds. In England, at least, the farmer seems to gain little ground in his war with the thistle, the red sorrel, the groundsel, &c.

Mr. King next states that a bird renders a service when it feeds upon injurious mammals, such as squirrels, gophers, rats, mice, and hares. Further evidence is here given of the damage done by squirrels, especially *Sciurius Hudsonius*, in devouring the eggs and young of the small insectivorous birds. Again, a bird may do service by feeding upon injurious birds and reptiles. Concerning snakes it is pointed out that much remains to be learned. Many species, not directly hurtful to men, do us indirect disservice by preying on frogs and toads, newts, fish, small birds, &c. Hence a snake-devouring bird is to be regarded as beneficial except it has counterbalancing habits.

The greatest service which birds render us is, however, in the destruction of noxious insects. We here meet with a passage against which we must put in a decided protest. Mr. King writes:—"Wherever the English sparrow, the bird so much decried in our country of late, has been exterminated in Europe, noxious insects are said to have followed in such abundance that it has not only been gladly reinstated, but is now protected because it accomplishes what parasitic and predaceous insects are unable to do." If such an assertion is made in any scientific treatise, as distinguished from the mythology of zoophilism, the alleged multiplication of noxious insects will be due to the

fact that true insectivorous birds were destroyed or scared away by the clumsy methods used in the war against the sparrow. In a later part of his work Mr. King expresses an opinion much more in harmony with facts. He writes:—"I believe it (the English sparrow) to be a bird for which we have no present need, and that it is positively in the way of a score of more useful species. The bird has very few of those qualifications, indeed, which are combined in good insect-destroyers, while it has many traits which are positively vicious. One chipping sparrow (*Spizella domestica*) is worth two score of these imported gamins."

The author shows further that a bird may serve men by preying upon slugs and snails. These mollusks are, indeed, much less numerous and destructive in America than in the moister climates of Western Europe.

The mischief done by birds is next considered. It is shown that a bird is harmful if it preys upon earthworms, when it destroys carnivorous insects, spiders and myriapods, and the parasites of noxious species. Here we find ourselves in a singular dilemma. The very same species which serve us are also ready to injure us. Each species fights for its own hand. There is scarcely an insect-eater which entirely abjures fruits and the buds of trees, and when preying upon insects it devours indiscriminately the zoophagous and the phytophagous. This principle pervades the entire animal world. The mole devours the larvæ of the useful *Carabus* as eagerly as those of the destructive cockchafer or daddy-longlegs. The weasel assassinates the mole as readily as the field-mouse.

The number of yet unsolved questions raised by Mr. King is surprising, and many observers must spend years in patient labour before half of them can be solved, even for the United States. We should hope that his treatise will be republished as an independent work; there are few parts of the world where it would not be serviceable. We could wish that similar researches might be undertaken in India, Australia and South Africa, and the West Indies.

Selections from Previous Works, with Remarks on Mr. G. J. Romanes's "Mental Evolution in Animals," and a Psalm of Montreal. By SAMUEL BUTLER. London: Trübner and Co.

WE have here selections from several of the author's former works,—from "Erewhon" from the "Fair Haven," from "Life and Habit," from "Evolution, Old and New," and from "Unconscious Memory." There are also remarks on "Mental

Evolution in Animals," by Mr. Romanes, selections from "Alps and Sanctuaries," and the "Psalm of Montreal," mentioned on the title-page. Two of the works in question—to wit, "Evolution, Old and New," and "Unconscious Memory"—we have had the pleasure of noticing in the "Journal of Science" some time ago. Two others—the "Fair Haven" and "Alps and Sanctuaries"—cannot legitimately come within our cognizance, though they may assist us in reaching a correct estimate of the author's opinions and ways of thinking. To form such an estimate is no easy task. The whole work, indeed, bears marks of an ability which it would be idle to depreciate. But we can scarcely say whether it is richer in ideas of value or in matter to be condemned. The author's views, on most questions, go completely askew of those commonly accepted at home or abroad, in the present or in the past. He sees the world as no one else sees it, and therefore often in a very instructive light.

We must not forget to point out that in all this there is no affected singularity, no straining to be original. By birth and breeding he is a citizen of the realm of paradox. These characteristics appear most strikingly, perhaps, in "Erewhon,"—the strangest, and probably the most repulsive, Utopia ever written. So repulsive, indeed, that were the "Erewhonians" actual beings a crusade for their extirpation would seem not merely legitimate, but imperative. But in reading the chapters taken from this book we are constantly in doubt whether Mr. Butler propounds Erewhon as a model for imitation, whether he is not satirising certain world-betterers and maudlinists in our own country, or whether he is not simply following his natural bent for inverting, reversing, and turning things in general topsy-turvy. He says, indeed, of the Erewhonians,—and the remark is not uncharacteristic,—"The people whose sense of the fitness of things was equal to the upraising of so serene a handiwork" (*i.e.*, an architectural masterpiece) "were hardly likely to be wrong in the conclusions they might come to upon any subject." Surely a most delusive test?

The main peculiarity of the Erewhonians is that they punish sickness, and cure, or pretend to cure, crime. They have no physicians, but in their stead a class of beings called "straighteners," one of whom is voluntarily called in by a scoundrel who has committed arson, forgery, robbery with violence, or the like, in order that he may be restored to moral health,—a most improbable supposition, especially among a community which does not attach to crime the disgrace which it incurs among sane people. It may be useful to meet the sophistry of the judge by pointing out those distinctions between disease and crime which ought to forbid any rational person from even imagining that their respective treatment can be convertible. Disease is a state for the most part entirely out of the control of the sufferer. Crime is an act or series of acts, each

perfectly within the control of the rogue or the ruffian. No person can say that he has a direct vested interest in his neighbour's health, save in the case of infectious diseases. Every man has a distinct interest in the absence of crime from the community. He has, so to speak, a direct personal quarrel with the criminal, which, in civilised society, he hands over to judge, jury, gaoler, and if needful to the hangman. But who can say that he is in the remotest aggrieved if some one in the next street suffers from neuralgia, or bronchitis, or asthma, or gout?

Again, even if for argument's sake we admit the sick man to be a nuisance, we find that he either recovers—and in that case ceases to be a nuisance—or dies prematurely, and then equally troubles us no longer. But the criminal does not cease to commit crime, nor does he, save for the interference of the law, die sooner than he otherwise would have done. The sick man, again, craves to be restored to health; the criminal does not crave to become a law-abiding citizen, though he may be desirous to escape detection and its consequences. Lastly, we can in most cases ascertain whether the invalid is restored to health or not; but we have no means of judging whether the criminal is really "cured," or if he is merely biding his time. This subject, however, cannot be here pursued further, from want of space.

The "Colleges of Unreason" in "Erewhon" are perhaps not such exceptional institutions as the author imagines. For what else, after all, are all our institutions for cram and examinations? Of examinations, indeed, Mr. Butler is not enamoured, though he unfortunately believes that all universities are necessarily examinational.

Turning to the end of the book we find the "Psalm of Montreal," a poem, and one with which we can have little sympathy. Mr. Butler, it seems, visiting the Montreal Museum of Natural History, found a statue of the Discobolus "banished from public view to a room where were all manner of skins, plants, snakes, insects, &c., and in the midst of these an old man, stuffing an owl,"—in other words, the curator's workroom. Mr. Butler was wroth, and "a dialogue, perhaps true, perhaps imaginary, perhaps a little of one and a little of the other," gave rise to the author's lines. To his protest the curator is represented as replying:—

> "The Discobolus is put here because he is vulgar,
> He hath neither vest nor pants with which to cover his limbs;
> I, sir, am a person of most respectable connections,
> My brother-in-law is haberdasher to Mr. Spurgeon." (*Sic.*)

Now the proper reply of the curator would have been that the Discobolus, in a Museum of Natural History, however beautiful in itself, is simply "matter in the wrong place," *i.e.*, dirt. It is also hard for us to believe that any naturalist would bring forward a connection with Mr. Spurgeon as a claim to consideration.

Had he said "to Darwin or Haeckel, to Agassiz or Leconte," this dialogue would have had a greater semblance of probability. The *refrain* "O God! O Montreal!" is little suited to English tastes. To the Theist of every grade it seems irreverent, and to the Agnostic and the Atheist simply foolish.

From an examination of the Preface, as well as from other portions of the book before us, we learn that Mr. Butler's relations with his brother-evolutionists are, as diplomatists say, in a state of tension. He has a difference with Mr. Romanes, and remarks that "It is no longer usual for men of any but the lowest scientific standing to correct their misstatements when they are brought to book. Science is made for Fellows of the Royal Society, and for no one else, not Fellows of the Royal Society for Science; and if the having achieved a certain position should still involve being obliged to be as scrupulous and accurate as other people, what is the good of the position?" Again, "If I had not ere now had reason to set down Mr. Romanes as one who was not likely to be squeamish about trifles." These passages, which we find in the Preface, refer to an error made by Mr. Romanes in asserting that the late Canon Kingsley had sent to "Nature," in January, 1867, a letter on inherited memory. In reality, as Mr. Romanes has since shown, the quotation should have been from "Fraser" for June, 1867. Canon Kingsley there and then, treating of the migration of birds, writes:—"Something told him (the wood wren) that his mother had done it before him, and he was flesh of her flesh, life of her life, and had inherited her instinct, as we call hereditary memory, in order to avoid the trouble of finding out what it is and how it comes." Mr. Butler, however, is by no means fully satisfied. He writes:—"It is plain that he (Mr. Romanes) intends to convey the idea that Canon Kingsley advanced the theory that instinct generally is inherited memory, which indeed his words do; but it is hardly credible that he should have left them where he did if he had realised their importance."

At any rate the publication of Canon Kingsley's words with the exact reference to their source should exculpate Mr. Romanes from the charges brought against him in the Preface. Mr. Butler is not of this opinion. He writes:—"The late Mr. Darwin himself, indeed,—whose mantle seems to have fallen more especially and particularly on Mr. Romanes,—could not contradict himself more hopelessly than Mr. Romanes does." Again:—"Fortunately Mr. Romanes is not Mr. Darwin; and though he has certainly got Mr. Darwin's mantle, and got it very much too, it will not on Mr. Romanes' shoulders hide a good deal that people were not going to observe too closely while Mr. Darwin wore it." It is somewhat singular that whilst Darwin had, in the earlier part of his career, enemies so many, so influential, and so able, any faults or shortcomings of his could remain hidden to be ultimately detected by Mr. Butler!

But we must, for the present, pursue our examination of this strangely interesting work no further, the more as we hope at no distant date to lay before our readers an estimate of Mr. Butler's contributions to the doctrine of Evolution.

A strange oversight, on page 101, demands the author's attention. It is there said that Sir Humphry Davy discovered oxygen.

Proceedings of the Literary and Philosophical Society of Liverpool (during the Seventy-first Session, 1881-82). No. XXXVI. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

THIS volume is rich in excellent matter. For once non-scientific articles are in a minority in number. One of them, on the "Revision of the New Testament," by Dr. Nevins, seems so unmistakably theological in its character that we wonder its admissibility was not questioned.

We have first to notice a communication on Fresh-water Mollusca from Lake Tanganyika, by the Rev. H. H. Higgins. The author questions whether in all cases the morphology of the soft parts of mollusks affords better indications of blood-relationship than does that of the hard parts. He mentions that he has personally taken from the Sea of Galilee, and from a stream near Jericho, shells resembling those from Lake Tanganyika, and he refers to the conjecture that "the Valley of the Jordan, the Red Sea (then closed at the southern end), the Valley of the Upper Nile, and the great African lakes formed portions of one vast fresh-water lake system in Eocene times." Some of the shells in question, however, imitate marine forms. Mr. Higgins therefore asks whether they are vestiges of a time when Africa was submerged. "If so, we have Mollusca placed in one genus which in their pedigree were wide asunder—a converging instead of a diverging pedigree."

Mr. J. Linton Palmer calls attention to a curious ethnological fact: in the primeval implements hitherto found in the American continent the groove or gouge type prevails in the north, and the straight-edge or chisel in the south.

Mr. E. Davies, F.G.S., the President, delivered an Inaugural Address on Chemical Force. Its characteristic is a philosophic caution. The speaker admits that "in the simplest chemical reactions there is much that we cannot understand. The old philosopher, Kanada, knew as much as we; and *Adrishta*, the Unseen, is still the best name we can give to the chemical force. . . . . Nothing must be accepted as articles of scientific faith

to be accepted under penalty of scientific excommunication. . . . . When we cannot fully explain all that is involved in the formation of a drop of water, I think we ought not to dogmatise on the profound mysteries of life and sensation." This is well put.

"Some Popular Misconceptions of Darwinism," by Rev. S. Fletcher Williams, is a timely paper, though the author in the latter part of his paper uses the term Darwinism in its popular sense, as synonymous with Evolutionism. He combats the prevailing error that Darwinism undertakes to account for the origin of life. He shows that Darwin did not profess to penetrate this mystery, and that, in the words of Prof. Tyndall, the Evolution hypothesis "does not solve—does not profess to solve—the ultimate mystery of this universe." The author next touches the misconception that, according to Darwin, man is only a little more advanced than the brutes. Among the scoffers who make this assertion—one and all we believe ignorant, and contemptuously ignorant, of Biology—is mentioned Mr. Froude, in his Address at the University of St. Andrews. Another current assertion is, that if man has been developed out of the lower forms of life he is in danger of losing his soul and his hope of immortality. The worthy people who are moved by this dread would doubtless shudder if told that most, if not all, of the arguments advanced to prove the immortality of man apply with no less force to the brutes also. But, passing over this difficulty, the author asks—"If we are made out of the dust, where did we get our immortal souls? If we have developed out of some lower form of animal life, is there any more mystery about the soul than on the other theory?" The author justly maintains that "the theory of Darwin does not touch the question of my spiritual nature or my immortality."

The last popular outcry against Darwinism is "that it is godless, atheistic; that it involves the exclusion of God and of design from the universe." This view has found, it appears, an advocate in Mr. Gladstone, who, in his Address at the Shaw-street College, declared that in our time, "upon the ground of what is called Evolution, God is relieved of the labour of creation." We are here reminded of an utterance of his great rival, Earl Beaconsfield, to the effect that in the question as to whether a man was a monkey or an angel, he was "on the side of the angels."

Such sayings are the more to be regretted since, according to a prevailing English superstition, a member of the Privy Council, simply as such, and without any especial study, is entitled to deliver an authoritative opinion on any question whatever.

"On the Justifiability of Scientific Experiments on Living Animals," by Dr. F. Pollard, is an able paper, but the author curiously enough, does not see the argument which completely crushes the Bestiarians. After speaking of the cruelties inflicted

under the name of sport, he goes on to say:—"But I cannot say that they afford any reason why persons who think it better to begin by attacking vivisection should be precluded from doing so until all these pain-giving sports are done away with. Cruelty by one set of people is no excuse for cruelty by another set of people, and it is no justification of physiologists, if they are cruel, that farmers and poulterers, and rat-catchers and angling bishops, and country gentlemen and benevolent ladies are all cruel in various ways, or even that they are more cruel than physiologists themselves." The words we have just quoted prove that Dr. Pollard has failed rightly to apprehend the "inconsistency" argument. We grant that any person who believes that the infliction of pain upon animals is wrong under any circumstances, and who lives up to his belief, might be justified in beginning by attacking vivisection if he thought proper. But any one who does inflict pain, or who procures its infliction by others, has no logical right to say a word against vivisection, unless he can prove—which these worthies never even attempt—that the infliction of pain in pursuit of knowledge is less justifiable than for any other purpose. To the legal quibble that "two blacks do not make one white" (they may do in case of chemical combinations) we oppose the common sense proverb anent the kettle and the pot, or that sterner and more authoritative warning—"Thou hypocrite, first cast out the beam out of thine own eye, and then shalt thou see clearly to cast out the mote out of thy brother's eye."

We regret, further, to find that Dr. Pollard pays a very needless compliment to at least one prominent Bestiarian—that he accepts, in its main features, the disgraceful Act of 1876, and that he expresses no regret for the cardinal blunder of physiologists and of the medical papers in accepting this measure with good grace, in advocating loyal adherence to its regulations on the part of investigators, and deprecating further agitation on the subject. They were warned what the result would be, but they took no heed.

The paper on the "Metamorphoses of Lepidoptera from Santo Paulo, by E. Dukinfield Jones, C.E., a Corresponding Member of the Society, is a most valuable production. Not content, like too many naturalists when visiting tropical regions, with capturing specimens, he worked out the metamorphoses of 83 species, making drawings and giving descriptions of the larvæ and pupæ. He noted their habits, the time they spend in the larva and the pupa state, their manner of flight, the number of broods in the year, and a variety of other particulars. All this good, sound work was done without assistance, and amidst professional duties. The specimens, we understand, are all deposited in the Liverpool Free Public Museum.

The next volume of the Society's "Transactions and Proceedings" will be noticed in our June number.

Bulletin of the Philosophical Society of Washington. VOL. IV.

THIS volume, containing the minutes of the Society from October 9, 1880, to June 11, 1881, has been late in making its appearance. The first memoir we notice is on the "Animal Population of the Globe,"—a somewhat ambiguous title. It is here taken to mean a census of the domestic mammalia throughout the world. The grand total is taken at about 1500 millions, or substantially the same as the number of human beings. The writer concludes with some remarks on the moral bearings of domestication. He contends that man creates more life than he destroys, and that his methods of destruction are less painful than those of Nature. It may however, we think, be fairly questioned whether any creatures existing in a wild condition lead lives so miserable as those of the majority of beasts of burden.

Profs. Pumpelly and Smythe have been investigating certain important sanitary problems. They find that the filtration of water through many feet of fine sand is insufficient to remove "bacteroidal organisms—a proof that irrigation, or "intermittent downwards filtration," does not deprive sewage of its dangerous properties. The authors confirm Wernich's results, viz., that air passing over putrefying fluids does not take up organisms therefrom—a conclusion which seems to show that the danger of living near a polluted river has been over-rated.

Mr. Simon Newcomb communicated a paper on the "Relation of Scientific Method to Social Progress." The bulk of this paper scarcely comes within our cognizance, but we may legitimately and approvingly quote the following passage:—"I make bold to say that the greatest want of the day, from a purely practical point of view, is the more general introduction of the scientific spirit and the scientific method into the discussion of those political and social problems which we encounter on our road to a higher plane of public well-being." The same writer further remarks:—"I think Prof. Clifford was very happy in defining science as organised common sense. The foundation of its widest general creations is laid, not in any artificial theories, but in the natural beliefs and tendencies of the human mind." Is this so? Was not the doctrine of the rotundity and the rotation of the earth a flat revolt against these same "natural beliefs and tendencies"? Is not "common sense" still vaunted as being the safeguard of the British Philistine against Evolutionism?

Mr. S. M. Burnett, discussing colour-perception and colour-blindness, objected to the Young-Helmholtz theory, and also to the view of Prof. Hering, who assumes that there are in the retina three chemical compounds, which he names the *black-white*, the *red-green*, and the *blue-yellow*. He has devised a plan (published in full in the "Archives of Ophthalmology") for the

systematic education of the colour sense in children. It would be well if all the perceptions were systematically cultivated.

Mr. Gallaudet referred to the proceedings at the International Convention of Teachers of the Deaf and Dumb, and declared himself in favour of the oral method in contradistinction to that of signs.

Mr. J. W. Chickering gave an account of the elevations, the climate, and the flora of the Roan Mountains in North Carolina. The peculiar plants met with, even at altitudes of 6000 feet and upwards, are scarcely sub-alpine, and between 3000 and 4000 feet the forest trees are magnificent. The individual masses and ranges appeared to have been formed by the erosion of a table-land.

Mr. Lester F. Ward read a very elaborate memoir on the flora of Washington and its vicinity. The author describes with some humour the botanist's point of view, which, we may add, is precisely that of the zoologist in every department:—"Rich fields of corn are to him waste lands; cities are his abhorrence; and great areas under high cultivation he calls 'poor country'; while, on the other hand, the impenetrable forest delights his gaze, the rocky cliff charms him, thin soiled barrens, boggy fens, and unreclaimable morasses are for him the finest lands in a State. The axe and the plough are to him symbols of barbarism, and the reclaiming of waste lands and the opening-up of his favourite haunts to cultivation he instinctively denounces as acts of Vandalism. While all this may seem as absurd to some as does the withholding from tillage of great pleasure-grounds in the form of hunting-parks for the landed sporting gentry of Northern and Western Europe, still, when these parts of the world are compared with the artificially-made deserts of South-eastern Europe and Western Asia, caused by the absence of such sentiments, there may perhaps be dimly recognised a soul of good in things evil, if not a soul of wisdom in things ridiculous."

The author proposes a certain district along Rock Creek, near Washington, as a National Park, and urges its preservation for that purpose.

Passing to details, we find a list of cases of well-defined albinoism in seven species, including a *Vinca* and a *Rhododendron*. Four species have been found with "the flowers much doubled, as in cultivation."

Concerning nomenclature we find a very just remark:—"Some scientific men seem disposed to forget that it is the things rather than the names which constitute the objects of scientific study. There is a vast amount of true scientific observation made by mere school-girls and rustics who do not even know the name of the branch of science they are pursuing. A knowledge of a plant by any name or no name at all is scientific knowledge, and the devotees of science should care less for the means than for the end they have in view.

Touching the popularisation of science we read:—"If it could become as much of a disgrace to be found ignorant of the flora or fauna of one's native place as it is now to be found ignorant of the rules of etiquette or the contents of the last novel, devotees of botany and natural history would immediately become legion."

We are in general ignorant not merely of the contents, but even of the very name, of the "last novel"—would it were written!—but we never felt this ignorance a disgrace, nor have we ever met with any person who had the impertinence to regard it as such.

Mr. Ward does well to point out that while all forms of natural science so far from quenching the æsthetic faculties tend powerfully to develope them, that of Natural History, and especially of Botany, awakens such an interest in Nature and her beautiful objects that those who have once tasted pleasure of this class may well consider other pleasures insipid.

This volume, which we have thus cursorily noticed, affords throughout gratifying proof that the Philosophical Society of Washington is doing valuable work.

Volume V. will be noticed in our June number.

Notes on Natural Selection and the Origin of Species. By Francis P. Pascoe, F.L.S., formerly President of the Entomological Society. London: Taylor and Francis.

The author of this brief but suggestive pamphlet, whilst fully recognising the great principle of Evolution, does not feel free to accept "Natural Selection" as the one great agent in the origin of species. In this view he is far from singular. The saying that before selection can come into play there must be varieties to select among has passed almost into a truism, and we are therefore left face to face with the main question, whence comes the variation? Unlike, however, another recent critic of the doctrine of Natural Selection, Mr. Pascoe holds that "Darwin's object was truth, and nothing could exceed his readiness to admit a difficulty wherever it told against his views."

Mr. Pascoe raises a point with reference to the beetles found in Madeira. According to Wollaston nearly 200 out of the 580 species existing in Madeira are wingless, or at least unable to fly. Darwin accounted for this fact on the principle of Natural Selection, as those beetles which flew most would run the greatest risk of being blown out to sea, and would consequently be the least likely to survive and to leave posterity. But Mr. Pascoe remarks that the beetles of Madeira belong chiefly to the families Curculionidæ, Tenebrionidæ, aud Carabidæ, many of which, even in inland localities, are wingless.

The difficulty—first raised, we believe, by the "Edinburgh Review," and admitted by Darwin—is that variation, though useful, would be generally lost by subsequent intercrossing with ordinary individuals. Yet there are cases on record where an abnormally formed animal, though mated with a perfectly normal individual of the opposite sex, has transmitted its pecularities unimpaired, and even intensified, to its offspring.

The following passage is worthy of note:—"We admire the structure of the fore limbs (so well adapted for burrowing) of the mole; but the rabbit, an unsurpassed burrower, is no more adapted for burrowing than its congener the hare, which never burrows; the snake (*Trop. natrix*), without fins, like the viper, is a rapid and graceful swimmer, while the latter rarely goes near the water." Such instances might be multiplied to a large extent. In any case they cut in several directions at once.

On the same page, in a note bearing upon a question which has been lately raised, Mr. Pascoe says—"Without denying the advantages of concealment for safety, I have been struck with the habit of Brazilian butterflies alighting nearly in the centre of a leaf, where, of course, they are most conspicuous: only one exception occurs to me—*Helicopsis cupido*, which almost invariably seeks the under side. I have never seen a bird touch a butterfly." We have lately seen it questioned whether birds ever capture butterflies at all. We must confess we never saw a bird in the act; but we have seen the damaged wings of butterflies, lacking the body, in situations where they could only be accounted for as having been left by some bird which had devoured the remainder. On the other hand, Dr. Fritz Müller, in order to prove that the protection which insects obtain by dint of peculiar odours, mimetism, and the like is far from perfect, forwarded to the Entomological Society a case of butterflies all of which had apparently been struck at by birds. Mr. Bates, too ("Naturalist in Nicaragua," p. 316), speaks of having observed a pair of birds bringing butterflies to their young. But not a few observers whom we have questioned have never seen a butterfly actually captured by a bird.

On one point we must join issue with Mr. Pascoe. He writes: "In the Scarabæidæ we find one section passing their lives in mammalian excreta, and another section living in flowers or among foliage, they having the same peculiar laminiferous antennæ, which on the theory of special advantage should hardly be suitable to both." But all, or nearly all, the Lamellicornes are very limited in their selection of food, and, being for the most part slow crawlers and heavy flyers, they require senses which may direct them at once to their food. We think Mr. Pascoe will find, on examination, that the complexity of the antennæ in insects varies almost inversely as the locomotive powers, and as the development of the eyes.

The matter in the pamphlet before us would have been drawn out by certain writers into a bulky volume.

Geology of Wisconsin. Survey of 1873-79. Vol. IV., accompanied by an Atlas of Maps. Published under the direction of the Chief Geologist by the Commissioners of Public Printing. 1882.

THIS volume deals with the Upper Mississippi region, the Lower St. Croix region, the ore deposits of South-western Wisconsin, the quartzite of Barron and Chippewa counties, the Flambeau region, the crystalline rocks of the Wisconsin Valley, the superficial geology of the Upper Wisconsin Valley, and expounds, lastly, the character and methods of the geodetic survey.

It is especially to be noted to what an extent the evils resulting from the reckless destruction of forests have forced themselves upon the notice, not merely of scientific theorists, but of far-sighted practical men throughout America. We know that not a few authorities are of opinion that all the water of our globe will be ultimately absorbed into its interior, leaving the surface arid. To prevent, or at least retard, this process is within the power of man if he will only use the knowledge which he possesses. But if in that greed which is the dominant feature of modern life he "clears" the country the result is, locally, the conversion of fertile land into a desert, and, generally, an impulse given to the desiccation of the earth.

As regards the quantity of moisture pumped up from the earth bo trees and restored to the atmosphere, Dr. J. M. Anders has made some very interesting determinations. He finds that the average evaporation from soft thin-leaved plants in clear weather is about 1¼ ozs. troy for every square foot of surface per day of 12 hours. Hence a single elm, of no very large size, would throw off 7¾ tons of watery vapour in twelve hours, and a grove of 1000 trees, oaks, maples, &c., would exhale over 45,000 "barrels" of water during every clear day of its season of growth. It is too much to assume that, without the agency of the trees, this water would all have been restored to the surface by the agency of springs. The author notes that there has been an evident increase of rainfall over certain areas on the plains of Colorado which have been irrigated for five or six years and planted with trees, &c. It seems to him that vegetation has contributed to this result by pumping up the water running beneath the surface. The roots of many trees penetrate the ground to the depth of twenty feet and more.

It is asserted by some that throughout the prairie region of America the annual rainfall is, in three years out of five, sufficient for the purposes of the farmer. The author contends, however, that in the denuded regions vegetation would be improved if the rainfall were more distributed, so as to render the heavy rains lighter and light showers more frequent. In Europe, he adds, floods are known to be more numerous, and in Asia droughts more frequent, since vast forests have been destroyed.

This perfectly true: the desolation of much of Spain, North Africa, Syria, Persia, &c., is due to the same cause. Or to look at a small, and therefore a definite case, we were shown, many years ago, a small stream, a tributary of the Oder, which, within the memory of the oldest inhabitant, turned a couple of corn-mills, but which now, since the forests about its sources have been removed, is throughout the summer merely a dry ravine, save for couple of days after a heavy thunderstorm.

This question has for us, in the home kingdoms at least, little direct practical interest. The denudation of Great Britain and Ireland affects the farmer and the gardener more by giving play to bitter winds than by preventing showers, which, like the poor, are "always with us." But in India, Australia, and South Africa the preservation of the forests is a question of vital importance.

Certain of the author's remarks on the distribution of vegetation show that he is fully alive to the truth first put forward, we believe, by Dean Herbert, that plants do not always grow by preference in the soils where we find them. On the contrary, a barren moorland serves often merely as a refuge where certain species retire from encroaching rivals, just as certain human tribes have fled to the deserts and the mountains as a refuge from invasion.

The Upper Flambeau region is exceedingly interesting from the evidences of glacial action which it presents. The accompanying map shows eight successive belts of moraine, lying in nearly parallel curves on a line proceeding from the north-east to the south-west. The small lakes and tarns are practically too numerous to be counted, and there are likewise a great number of "kettle knolls" or "knobs," sometimes 100 feet in height, and often occurring in the midst of marshes. Huge boulders are numerous, and may often, except carefully examined, be mistaken for rocks *in situ*. It is concluded that in this district there were three periods of glaciation, whilst the eight belts indicate as many minor periods included within the larger ones.

The entire volume before us proves fully that time and labour have not been spared in this geological survey, and that the work has been done in the spirit of thoroughness.

Where did Life Begin? A brief Enquiry as to the Probable Place of Beginning, and the Natural Courses of Migration therefrom, of the Flora and Fauna of the Earth. A Monograph. By G. HILTON SCRIBNER. New York: Charles Scribner's Sons.

THE author's hypothesis is substantially that at the very outset of geological time the earth's surface first became sufficiently cooled and consolidated to admit of the existence of animal and vegetable life at or near the North Pole, and that with progressing refrigeration the fauna and the flora were gradually driven down towards the tropics, becoming more and more differentiated the farther they receded from the place of their origin. This view, if not explicitly stated, is shadowed forth in Mr. J. A. Allen's system of animal geography, and is even, to a certain extent, implied in a remark by Mr. A. R. Wallace. The latter naturalist likens the existing continents to some huge tree, having its roots in the Arctic regions, filling great part of the torrid and temperate zones with its matted boughs, and sending out three out-shoots towards the South Pole. This similitude certainly suggests that the flora and the land fauna would correspond in their origin and migrations to the growth of their home.

The first question we have to ask is one which can only be solved by the physicists. Did the earth's crust really become first solidified at the poles? On this point we must confess ourselves unable to pronounce a valid opinion.

Perhaps, however, even the contrary view, *i.e.*, the simultaneous solidification of the earth's crust, would not be necessarily fatal to Mr. Scribner's hypothesis. We can easily conceive that under those circumstances the poles would be the coolest parts of the earth, whilst the intermediate regions were still too hot for animal or plant.

If the physical difficulties of the case can be got over, the evidence seems decidedly in favour of the author's view. The facts of animal geography seem in favour of migrations directed from north to south, rather than from east to west, or *vice versâ*. Within the Arctic circle the fauna shows comparatively little differentiation, so that Mr. J. A. Allen proposes in his classification one single Arctic region. Within the temperate zones the Palæarctic and Nearctic regions of Dr. Sclater and Mr. Wallace have still so much in common that Mr. Allen feels authorised to consider them as one primary region. As we go farther south the divergence increases. The fauna of Africa and South America are sharply contrasted.

Again, if we look at the palæontology of the case, we find evidence in high northern latitudes of a flora of temperate, or even subtropical, character,—proof of a climate very different from, and much superior to, that of lat. 55° to 60° at the present day.

The question here arises, why do the continents appear to begin at the North Pole in preference to the South? Has the bulk of the dry land always existed in the Northern Hemisphere and the bulk of the ocean in the Southern? Or have we here a case of alternate fluctuation, as suggested by Adhemer and others? We do not know that the compatibility or incompatibility of this hypothesis with the phenomena of organic distribution has ever been exhaustively studied.

The Mason College Magazine. Vol. II., No. 2. Birmingham: Cornish Bros.

We notice here a very important address on the "Progress of Chemistry," delivered by Prof. Tilden at the Inaugural Meeting. After a survey of the rise and progress of the science, and after noticing the modern pre-eminence of Germany in chemical research, the speaker asserted that "England is now in a fair way to retrieve her fallen fortunes. Abundance of good work is being done. . . . In the matter of instruction we are very little behind the Germans, and we are very rapidly gaining upon them." He then enumerates the college laboratories which have been erected and fitted up of late years. He continues:—"We have all these opportunities of teaching and learning chemistry, and yet we are not satisfied. What more do we want?" His reply is good as far as it goes, but imperfect, the main point being omitted. He answers:—"Among other things we want more money for material and appliances, more students, more leisure for the professors, more sympathy from the governing bodies in our work alike of teaching and research, more intelligent recognition of the usefulness of chemical knowledge by chemical manufacturers." But is this the sum-total of our deficiencies? Prof. Tilden himself shall supply the answer, though he fails fully to see it. He says:—"If we go into the iron- and steel-works of the North of England, into the dye-houses and print-works of Yorkshire and Lancashire, into the alkali-works of St. Helens and on the Tyne, we find the laboratories literally swarming with Germans, who are holding the situations which ought to be occupied by Englishmen. How long this state of things is to exist is a question which is entirely within the power of young English chemists to determine."

We have no need to point out what a fearful indictment the lecturer has here drawn up against the Science and Art Department. But we must ask ourselves whether it is within the power of young English chemists to render this invasion of aliens henceforth impracticable? To do this we must glance at the

systems of scientific and technical education which obtain respectively in England and in Germany. Our system is throughout examinational. The student is constantly preparing for some examination which he must necessarily "pass." The teacher—in all cases at least which come under the control of the Department—is paid by what are misnamed "results"; that is, by the number of his pupils who succeed in "passing." As long as this system prevails the English student and the English teacher are alike powerless.

The German system of science-teaching is totally different. A young man enters a university, and attends the class-room and laboratory of Professor M. or N. If he shows zeal, industry, and intelligence, the Professor, who keeps a watchful eye on every student, gives him some idea to work out experimentally, and assists him with advice and suggestions. When the investigation is completed it is sent for publication to one of the scientific journals, and the youth sees his name bracketted with that of a Hofmann, a Baeyer, a Kolbe, &c. More and more difficult problems are placed in his hands, and the assistance of the Professor is gradually withdrawn till he feels himself fully capable of original research, whether in speculative or applied chemistry. It is the interest of the Professor to detect, train, and bring out ability. The researches and discoveries made by his class are his "results." The more numerous and important such researches, the more students flock to his laboratory and his lectures. Rival universities contend for his services, and Government awards him public honours. Is it not plain as daylight that students thus trained must have more original, suggestive minds, and must be of more use in a chemical manufactory, than those whose great aim has been to pass examinations? To Prof. Tilden's question, "What more do we want?" the reply is simple. We want abrogation of "payment by results," and of the examinational system altogether. But to that system we cling

> "Like a torpid bat
> To a dead bough."

It is painful to hear eminent men complaining that in these days men study not to know, but to pass, and yet themselves take the "devil's arles" for upholding this delusion.

Mr. Evans read an interesting paper on "Feathers," and regretted the wanton slaughter of thousands of harmless birds at the dictates of fashion. Had we our will no *modiste* would dare to offer for sale the feathers of humming-birds, trogons, birds of Paradise, &c.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

SIMSON'S "HISTORY OF THE GIPSIES."

THIS work, edited by me, was ready for the press in 1858, and was published in Great Britain and the United States towards the end of 1865. When submitted to the American press I find that it was accompanied by the following circular:—

"Herewith is respectfully submitted for criticism a copy of a 'History of the Gipsies,' just published, which, it is presumed, will prove, in some degree, a subject of interest, investigation, and discussion to the American people.

"The pivot on which the real interest in the Gipsies, during the past, the present, and the future, turns, is the phenomenon of the occasional amalgamation of other blood with theirs, their settlement, and the civilisation, perpetuity, and increase of the people, maintaining their identity in the world, notwithstanding their having no religion peculiar to themselves, like the Jews. The principle, or rather fact, here involved, is evidently very difficult of comprehension by the British mind, owing principally, it may be said, to its practical unfamiliarity with the idea of two distinct races living on the same soil, the extreme prejudice against the Gipsies, and the consequent singular incredulity towards anything good or sensible that may emanate from them as a race. In America the first-mentioned difficulty does not exist, while the distance from the location of the people principally described somewhat obviates the second and third.

"There is also a general difficulty to be overcome in the way of the present volume, in its more peculiar characteristics being allowed to pass current in the world,—and which seems to be inherent in human nature,—*viz.*, a disinclination to believe anything new on a subject which everyone imagines he knows, or which no one is presumed to know. In conducting an enquiry like the one mentioned, a simple regard to facts is the sole legitimate object of contemplation; it not being even necessary to understand *why* or *how* a phenomenon exists, to believe that it *does* exist. For example: no one professes to understand how it is that the Jews exist in their scattered state, yet no one denies, or even doubts, their existence on that account. In the present

volume, it may be said that the reasons given for the existence of the Gipsies in a civilised state are amply sufficient to explain, connect, and substantiate the various facts discovered.

"New York, 1866."

This should not prove without interest to a large part of English readers. It has been a matter of great surprise to me that in Great Britain there should have been, and should still be, such a strong aversion to examine, discuss, and do justice to this subject, which applies to a relatively large body of people whose blood for the most part is *not* Gipsy, but that of the ordinary one of the country. In "The Gipsies," as illustrated by John Bunyan, Mr. Carlyle, and others, published in 1883, I wrote as follows:—

"In my additions to the 'History of the Gipsies,' I think I presented every aspect in which the subject could be viewed. . . . I stated at great length on these occasions how the tribe acquired the names of the ordinary natives, how its blood got mixed, how it gradually swarmed from the tent and progressed, how it maintained its identity and will do so for the future, and what it is that in its essence constitutes a Gipsy, as distinguished from the nationality or family of other people" (p. 27).

JAMES SIMSON.

New York, March 25, 1884.

TECHNICAL EDUCATION.

I HAVE read with much interest the able articles on Technical Education contributed by Mr. Galloway to the "Journal of Science." The articles have opened up a subject of vital importance to Englishmen. The signs of the times unquestionably point to the decay of England's supremacy in the Arts and Commerce, and Mr. Henry George—no mean authority—has recently stated that, in his opinion, England has entered upon her period of decline.

The question arises, Why should England ever decline until her natural resources are exhausted? There is no reason, except it lies in the perversity of the official system which forces upon us inadequate methods of Technical Education which have for their only result a vast and useless expenditure of public money.

I have from time to time had ample opportunity of observing persons trained under the Science and Art Department, and I have been led to the conclusion that the training has been of little value in fitting them to take an intelligent part in commercial life, and I have been especially impressed by the almost

total want of originality of thought which such students have exhibited.

I trust that the articles will have the effect of calling the attention of independent educational reformers to the defects of our present system. It would be well if a Royal Commission, or some other form of inquiry, were instituted.

AN ENGLISH MANUFACTURER.

BESTIARIANS IN PARLIAMENT.

SURELY all medical practitioners, and scientific men generally, should see the importance of ousting Bestiarians from Parliament at the next election, and of using their best endeavours to prevent the return of any more of the fraternity. For such an object I submit that, for the time being, party considerations ought to be merged, and a solid vote given against the enemies of Science. It is rumoured that a Bestiarian will be nominated at Sheffield, and I trust that the profession in that town will leave no stone unturned to prevent his election.

A GRADUATE.

THE DEVOTION OF LOVE-BIRDS.

IT is commonly believed that if one of a pair of love-birds dies the survivor will mope and pine away. I have an instance to the contrary. Of a pair in my possession the female died about five weeks ago, after a very long illness. Her mate, however, instead of moping, seems as happy as the day is long, and does not seem in the least to miss his spouse.

E. S.

NOTES.

At a Meeting of the Liverpool Medical Institute Dr. Howie, as reported in the "Medical Press and Circular," discussed the influence which the present system of education has upon the health of the community. He held that it is the duty of medical men to insist upon the evil effects which are certain to follow if the present course is persistently pursued. Confining his remarks entirely to children under twelve, he said that no such child ought to be called upon to perform any kind of work, whether muscular or mental. That four hours *mental exercise* is enough, twelve hours in bed, four hours for meals, &c., and four for muscular exercise. That much as he believed in education as a means of national improvement, yet it would be better to have the masses uneducated than to train their minds at the expense of muscular strength and dexterity. Reading and writing, although extremely important, yet were not absolutely essential to the highest education; that facts themselves, without the ability to think and speak correctly about them, are of but small advantage in mental training. Under the existing educational code teachers are compelled to force into the minds of their pupils information for which they are utterly unprepared, either by age or by previous training. That the blame rests on the framers of this code who have utterly ignored the brain capacity of children, and not on the schoolmaster or inspector who are simply acting in accordance with their directions. Throughout the whole course of a child's school career most of the subjects of study are quite beyond his intelligent grasp, unless he is specially precocious. He then described at some length the influence which close confinement in school-rooms had upon the health, by inducing a tendency to frequent bronchial catarrhs, which in children of phthisical history will ultimately lead to that disease, and quoted several cases from his own experience in support of this. He also spoke strongly in favour of the half-day system of schooling. In our elementary schools it was not so much actual over-work as excessive stimulation of the growing brain which leads to its far too rapid growth to be healthy; the nerve structure is through this rendered extremely sensitive, and lacks stability. In order to remedy the present system he suggested that, first of all, we ought to choose good teachers, and give them a considerable amount of freedom in dealing with the pupils, and to abolish the system of payment by results. He therefore proposed that a Committee should be appointed by the Institution to inquire into

the question of over-strain in elementary education. This resolution was carried unanimously.

M. Cholodkovsky ("Comptes Rendus") has discovered that, in addition to certain Coccidæ as previously known, *Tineola biselliella* has only two Malpighian tubes. All other Lepidoptera have always six Malpighian tubes, and in general the anatomy of species of this order is more uniform than in the other orders. The caterpillar of this species has, like all other Lepidopterous larvæ, six Malpighian tubes. The researches of Rathke and Fritz Müller have sufficiently shown that a low number of these tubes is a primitive feature, and that with the progressive development of the organism during its metamorphosis the number of its tubes increases. In the Tinea we find the very contrary. It is probable that its remote ancestors had merely this number. We have, then, before us, a case of atavism quite exceptional in its character as occurring regularly. This *periodic atavism* seems to be a fact quite new to Science.

M. Dieulefait infers, from the presence of manganese in cipoline marbles, that both these marbles and the gneiss which encases them have been formed in water.

M. Minard has laid before the French Academy of Science a method for attenuating the violence of storms. He proposes to use a great number of lightning-rods, elevated on telegraphic posts and connected to the metals of railways.

Dr. H. C. Tweedy, in a paper read before the Public Health Section of the Academy of Medicine in Ireland, commits himself to the following utterance:—"Self-destruction is a crime in the eye of the law, and he who attempts it is *justly* liable to punishment." We deny the justice of punishing actions which interfere neither with the personal safety nor the property of the public.

MM. Soret and Sarasin ("Comptes Rendus"), on re-examining the absorption-spectrum of water, find in the orange a very faint and narrow dark band, a little less refrangible than the ray D, at about the fifth part of the interval between C and D, nearer D, and corresponding approximately to the wave-length 600.

The rejection of the motion for the Sunday opening of Museums was to be expected. Whilst recognising the feeble character of the arguments used against it, we cannot help noticing how much the question is complicated by the establishment of Museums in, or their transfer to, remote un-central localities, and by the opening in these institutions of "refreshment-rooms."

Mr. J. Gunn, F.G.S. ("Geological Magazine") contends that the changes of the climate, and of the Fauna and Flora, are most probably due to the alternate elevation and subsidence of mountain-ranges.

It is surely a sign of the times that a journal exists bearing the name of the "Competitor," and further styling itself "A Civil Service and University Examination Journal and Review." Even China can scarcely go so far!

The "Warrington Guardian" remarks that "the 'cramming' system is flourishing all over Britain undisturbed, and is working havoc among both the youth of the land and their teachers, who are succumbing to the mental strain put upon them at a most uncomfortable rate."

Dr. Landwehr ("Zeitschrift für Physiolog. Chemie") has succeeded in obtaining an animal gum, closely resembling the plant gums in its physical and chemical properties, and forming a new link between the animal and the vegetable kingdom.

We hear of a chemical manufactory, in Cheshire, in which not a single British subject is employed in any position of trust. What a commentary on our system of scientific and technical education, and on the "Department" by which it is administered!

Mr. E. A. Freeman, the historian, has made himself conspicuous at Oxford as a Bestiarian, and has shown his complete misconception of the very nature of Science.

A tornado which passed last month over Alabama, Georgia, and the Carolinas, killed outright over 300 persons in Georgia alone.

Dr. N. A. Randolph, in a paper on the digestion of infants, reprinted from the "Transactions of the College of Physicians of Philadelphia," and courteously forwarded to us, proves experimentally that many infants under three months can digest starch foods; that no broad and general statement can be made as to the period at which infants *begin* to digest starches; and that the physician can be absolutely certain that a farinaceous ingredient in the diet of a young infant is beneficial only by an analysis of the dejecta under such diet.

The International Geodetic Association has recommended the universal adoption of the meridian of Greenwich, reckoning longitude in one direction only, from west to east.

We have great pleasure in learning that the statue of Liebig has been completely freed from the stains by which it had been so shamefully disfigured. The spots consisted of silver nitrate and potassium permanganate. By treatment with ammonium sulphide these metals were converted into sulphides, and were finally removed by applications of potassium cyanide, the marble remaining uninjured. The perpetrator of the outrage has not yet been detected.

"Science" gives an instance of a prolonged drought in Virginia having been broken by the ascent of a column of hot air from the conflagration of about 40 acres of scrub pines. Rain began in little more than an hour from the origin of the fire, and continued till sunset. During the rest of the season showers occurred with ordinary frequency.

Mr. G. P. Sanderson, in a paper read before the Society of Arts, rates the intelligence of the elephant very much lower than is ordinarily done. He has only met with one instance of an Indian elephant which exceeded 10 feet in height, being 10 feet 7½ inches.

Prof. R. W. Raymond ("Kansas Rev. of Science") says, concerning the divining-rod, that in one department after another it has been found useless. If it be worthy the attention of scientific students, it is the students of Psychology and Biology, not of Geology and Hydroscopy, who can profitably consider it.

At the recent Hertford sewage trial the learned judge made the mistake of saying that the "Phosphate Sewage Company" had worked the "A B C process" there unsatisfactorily. We are authorised to say that the "A B C" sewage-process has never been worked at Hertford at all.

Dr. S. W. Burnett ("Science") refutes Mr. Lawson Tait's assertion that "no other animals than cats are affected with congenital deafness." He gives two instances of dogs, deaf from puppyhood,—one of them, moreover, not white, but yellow.

The average cloudiness in Kansas ("Kansas Rev. of Science") is 44 per cent, as against 31 in California, 47 in the Southern States, 53 in New England, and 71 in Great Britain.

Mr. E. F. Hardman, Government Geologist in Western Australia, reports what he regards as an instance of suicide by black snakes. A half-killed snake was attacked by black ants in the wounded parts, when "it instantly turned round and bit itself twice in the neck, with seeming determination." In less than one minute it was dead, poisoned, Mr. Hardman believes, by its own venom. His men reported this to be a common occurrence.

According to the researches of M. Certes ("Comptes Rendus") there appear to exist at the bottom of the sea ærobic microbia, but no anærobic forms.

Sir Richard Owen has described a mammalian species from the trias of South Africa. This animal, which has received the name *Tritylodon*, approaches nearer to the *Stereognathus* of the oolite than to any other form, but is still so distinct from all known animals as to throw no light on the ancestry of the Mammalia.

M. Ch. Richet shows that the hydrochloric acid of the gastric juice exists chiefly in combination with pepsine.

M. P. Reynard has communicated to the French Academy of Sciences some important experiments on the influence of great pressures upon various forms of animal and vegetable life. Beer-yeast, after exposure for one hour to a pressure of 1000 atmospheres, was not killed, and was afterwards able to set up fermentation in a solution of sugar. Algæ, after exposure for an hour to a pressure of 600 atmospheres, were still able to decompose carbonic acid in the sunlight. Infusoria were submitted to 600 atmospheres for half an hour: they appeared at first torpid, but rapidly recovered. Mollusks similarly treated recovered more slowly. Leeches at the same pressure appeared to be dead, but recovered in a few hours. With crustaceans, such as *Gammarus puba*, the phenomena were identical, but the recovery more rapid. Fishes without swim-bladder survived a pressure of 200 atmospheres, but perished at 300. These experiments illustrate the conditions of life at great depths in the sea.

The after-glow of the evening skies is described as having been splendid during the months of October and November, at Adelaide. Since then it has been gradually decreasing, but even on February 24th it was still visible as a fiery band on the horizon.

"Science" mentions a peculiar north wind felt in California, and which, whether hot or cold, "produces a feeling of great depression and nervous irritability, lassitude and restlessness." Its effects upon vegetation in summer are scorching.

Dr. Delaunay, in the journal of the Ethnographic Society, says that the civilisation of Europe has been retarded by influences from Asia. "Not to speak of cholera, plague, and other maladies, two-thirds of our intellectual lives are spent in perpetuating the errors and exploded fancies of Asiatic, Greek, and Roman mythmongers."

A deposit of gold has been discovered at Penaflor, in Andalusia.

M. J. Deniker ("Comptes Rendus") describes a fœtus of the gorilla in the fifth month of its life. In almost every respect it approaches closely to the form of the human fœtus at the same age. The hand differs from that of the adult gorilla by the greater proportionate length of the fingers. The leg is cylindrical, without the projection of the calf evident in the human fœtus. The cephalix index is 86·2.

According to M. G. Carlet ("Comptes Rendus") all the muscles of the abdomen of the bee, with the exception of those connected with the circulation, subserve respiration, and consequently the development of heat. By means of these muscles the abdomen can be expanded or contracted in all its three dimensions for the admission or expulsion of air by the stigmata.

M. Thollon, writing from the Nice Observatory to the Academy

of Sciences, states that, whilst prior to November last the sky had an intense blue tint up to the very margin of the solar disc, there now appears around the sun a dazzling white halo, of about 15° radius, slightly tinted with red outwardly and with blue inwardly.

M. Perrotin remarks that the general aspect of Uranus resembles that of Mars rather than that of Jupiter.

M. E. L. Trouvelot ("Comptes Rendus") considers that the so-called "polar spots" of Venus are the summits of lofty mountains which rise above the stratum of vapour enveloping the body of the planet.

Dr. Maercker maintains that cellulose is not truly digested by mammals. The portion which disappears during the digestive process is not assimilated, but converted into gases.

According to MM. Kellner and Imai the soil of Japan is by no means rich,—a conclusion founded both on chemical analysis and on the character of the prevailing vegetation.

A controversy on the "law of thermic substitution constants" is going on between Prof. Berthelot and Dr. Tommasi. On March 18th the latter chemist requested M. Bertrand, the Perpetual Secretary of the Academy of Sciences, to lay a certain memoir before the Academy. M. Bertrand remarked that, "as the discussion threatened to be prolonged, before deciding on inserting the memoir in the "Comptes Rendus" it would be well to submit it to some chemist belonging to the Academy. Having thus spoken he handed the paper to M. Berthelot (!), who was thus constituted judge in his own case. As a consequence, easy to be foreseen, the memoir has not appeared in the official journal. Such is official Science all the world over!

Metallic chrome is found to be, of all metals, the worst conductor of heat.

A pamphlet has just appeared at Leipzig which aims at proving that leaden service-pipes for water are free from danger.

The Hindus, we learn, regard the smallpox as a goddess whose visitations should not be in any way interfered with. Do some worthies at home entertain a similar reverence for smallpox, and still more for syphilis?

The Councils of the Entomological and—we believe—of the Linnean Societies find, to their regret, that they have no power to sign petitions in favour of Prof. Bryce's Bill without the step of calling a special general meeting for the purpose, which would come too late.

"Cosmos les Mondes" quotes a new German remedy for diphtheria (rectified oil of turpentine), and adds "let us beware of what comes from Germany."

The texture of sponges is said to become denser and finer the higher the latitude of their place of growth.

M. Boutigny, well known for his researches on the spheroidal state of liquids, died on March 17th, in his 86th year.

We learn that attempts are being made at Coblentz to use the raven as a substitute for the carrier-pigeon. It is less likely to be attacked by birds of prey, but it is much less plentiful, and does not, we believe, ordinarily breed in domestication.

A popular society for the study of Natural History is in course of formation at Warrington.

Miss F. M. Hele ("Science") has observed that the lemon-coloured variety of *Helix aspersa* is changed to a dirty brown by a diet of lettuce. The eggs of the modified specimens, however, produce only individuals of the normal colour.

Dr. J. M. Anders ("American Naturalist") demonstrates the exhalation of ozone from flowering plants, and thus furnishes a sanitary reason for their multiplication in cities.

According to Leonhard Stejneger ("Naturen") the skies of Kamtchatka are bright, the climate mild, and the flora luxuriant. The fauna is palæarctic, with a few nearctic forms.

Mr. W. D. Le Sueur has produced an able "Defence of Modern Thought," in reply to a lecture on "Agnosticism" lately delivered by the Bishop of Ontario. We may take occasion to examine Mr. Le Sueur's pamphlet.

According to the "Journal of Physiology" Prof. Goltz has conclusively shown the absence of localisation of function, in the ordinary sense of the term, for the brain of the dog, whilst Prof. Ferrier has failed to establish his theory of localisation of function for the brain of the monkey.

In the "American Naturalist" mention is made of Prof. Harrison Allen's palate-myograph, by which spoken language is represented by a series of curved lines on a surface of white paper coated with soot.

Referring to the condemnatory evidence of Mr. Mundella on the system pursued by the Science and Art Department (see our last number, p. 217), the "Freeman's Journal" remarks appropriately:—"The question very naturally arises why the right hon. gentleman has made no effort, now he has the power, to make a reform the imperative necessity for which he advocated when the power was in the hands of his political opponents?"

Dr. Paul Bert ("Comptes Rendus") concludes that milk-sugar is produced by the mammary excretion of the excess of sugar produced in the organism after parturition, and formed very probably in the liver.

M. Ch. Brongniart ("Comptes Rendus") describes the wing of a gigantic fossil neurorthopterous insect from the coal-beds of Commentry. The wing is 13 inches in length, and the insect must have been nearly 20 inches in length and 27 inches in spread of wing. The insect belongs to the extinct genus *Dictyoneura*, and is nearly allied to the Phasmidæ of the present day.

The complete success of the German Zoological Station at Naples, which has led to the foundation of similar institutions by England, France, and the United States, inspires the semi-official "Norddeutsche" with the following Chauvinistic reflections:—"The effect of the thunder of Sadowa and Sedan is manifest also in the leadership of scientific enterprises which German courage and self-confidence have conquered abroad."

According to W. H. Penning the High-level Coal-field of South Africa covers an area of 56,000 square miles.

Prof. Römer gives an interesting account of the Bone-caves of Ojcow, in Poland. A translation of his memoir is noticed in the "Geological Magazine." Bones of more than sixty species of vertebrate animals, extinct and recent, have been discovered. The specimens do not differ from those obtained from the Bone-caves of Moravia.

Prof. Zittel ("Geol. Mag.") maintains, after careful examination, that the hypothesis of a Quaternary sea over the Sahara is not supported either by the geological structure or the surface characters of the Desert. A moist climate prevailed in North Africa during the Quaternary period.

We learn that at a meeting held in the rooms of the Royal Society it was resolved—"That in the opinion of this meeting there is an urgent want of one or more laboratories on the British coasts, similar to those existing in France, Austria, Italy, and America, where accurate researches may be carried on leading to the improvement of zoological and botanical science, and to an increase in our knowledge as regards the food, life, conditions, and habits of British food-fishes, and mollusks in particular, and the animal and vegetable resources of the sea in general." Prof. Ray Lankester is Secretary to the Provisional Council appointed to carry out the objects of the meeting.

[Should not one such laboratory be placed in Guernsey or Jersey?]